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SELECTED WATER RESOURCES ABSTRACTS

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1988 .

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

METHODS FOR THE STUDY OF WATER IN ICE PHASES,
Institut Max von Laue - Paul Langevin, Grenoble (France).
W. F. Kuhs.
IN: Biomembranes, Part O, Protons and Water: Structure and Translocation. Methods in Enzymology, Volume 127. Academic Press, Inc., Orlando, FL. 1986. p 303-318, 3 fig, 66 ref.

Descriptors: *Ice, *Water properties, *Molecular structure, Ice-water interfaces, Aqueous solutions, Chemical analysis, Lattice structures.

Ice is regarded as a key substance to understanding hydrogen-bonded systems. As such it is not only of considerable interest to solid state physics, chemistry, meteorology, glaciology, and astrophysics, but it is also essential for the biological sciences. Once the hydrogen bond properties of ice in all its forms are understood, a sound base can be laid for a thorough discussion of water, aqueous solutions, and other more complex hydrogen-bonded biological systems. The full range of experimental (and theoretical) methods for solid state research can be used to study the behavior of water molecules in the various ice phases; the usual lattice properties of the solid state offer a starting point for an understanding of the increasingly complex world of water and its biological functions. The application of various experimental techniques to the study of ice properties is reviewed, including crystallography, vibrational spectroscopy, nuclear resonance, and electric and dielectric methods. (See also W88-01593) (Lantz-PTT)
W88-01596

INVESTIGATION OF GROWTH INSTABILITIES OF THE ICE-WATER INTERFACE BY LIGHT SCATTERING SPECTROSCOPY,
California Univ., Davis.
For primary bibliographic entry see Field 2C.
W88-02275

1B. Aqueous Solutions and Suspensions

BIOMEMBRANES, PART O, PROTONS AND WATER: STRUCTURE AND TRANSLOCATION.
Methods in Enzymology, Volume 127. Academic Press, Inc., Orlando, FL. 1986. 830 p. Edited by Lester Packer.

Descriptors: *Chemical properties, *Protons, *Biological membranes, *Membrane processes, *Biochemistry, *Biomembranes, Chemical analysis, Molecular structure.

One of the main, unsolved problems in current research on biological membranes is the mechanism of ion transport. A major breakthrough to an understanding of this mechanism would be the clarification of how relatively simple substances, such as water and ions, interact with and are transported across membranes. In recognition of the importance of this problem, this volume attempts to present state-of-the-art methods used by leading experts on the chemistry and physics of protons and water and discussion by experts in the biological sciences working on fundamental problems of proton and water translocation. It is hoped that the availability of such a volume will stimulate new research, heighten awareness of recent discoveries in basic research, and focus attention on major questions in the field. Sections discuss: (1) interactions between water, ions and biomolecules; (2) theoretical/model membrane methods; and (3) natural membrane methods. (See W88-01594 thru W88-01597) (Lantz-PTT)
W88-01593

METHODS TO DETERMINE STRUCTURE IN WATER AND AQUEOUS SOLUTIONS,
State Univ. of New York at Stony Brook. Dept. of Chemistry.
H. L. Friedman.
IN: Biomembranes, Part O, Protons and Water: Structure and Translocation. Methods in Enzymology, Volume 127. Academic Press, Inc., Orlando, FL. 1986. p 3-21, 8 fig, 57 ref.

Descriptors: *Molecular structure, *Aqueous solutions, *Water properties, *Membrane processes, Chemical analysis, Chemical properties, Mathematical equations, Mathematical studies, Mathematical models, Model studies.

When describing the structure of a liquid, it is expected to be a picture showing the average atomic environment of each atomic species. In a fluid, the interparticle distances are not all sharply fixed, as they are in a crystal. The corresponding variability plays a very important part in both equilibrium and dynamic properties, so it must be taken into account in any picture that is generally useful. The most convenient description of the structure seems to be in terms of the spatial correlation functions. To determine structure in fluids, the relevant diffraction data needs to be supplemented by calculations of the properties of suitable Hamiltonian model systems, which fit the diffraction data as well as other properties of the real system. Some applications of this procedure to water and aqueous solutions are described. (See also W88-01593) (Lantz-PTT)
W88-01594

LOW-FREQUENCY RAMAN SCATTERING FROM WATER AND AQUEOUS SOLUTIONS: A DIRECT MEASURE OF HYDROGEN BONDING,
Howard Univ., Washington, DC. Dept. of Chemistry.
G. E. Walrafen, and M. R. Fisher.
IN: Biomembranes, Part O, Protons and Water: Structure and Translocation. Methods in Enzymology, Volume 127. Academic Press, Inc., Orlando, FL. 1986. p 91-105, 6 fig, 26 ref.

Descriptors: *Aqueous solutions, *Molecular structure, *Chemical analysis, *Water properties, *Membrane processes, *Raman scattering, Chemical reactions, Temperature.

The low-frequency Raman spectral region (delta v < 350/cm) from pure liquid water (and aqueous solutions) has been investigated by a large number of workers. For pure water, this spectral region is composed of two broad, weak Raman bands in the general vicinity of approximately 170/cm and 60/cm. The 170/cm Raman band from water and aqueous solutions, is of very great importance because it constitutes a direct measure, i.e., is diagnostic, of hydrogen bonding. In pure liquid water the 170/cm vibration, which is both Raman and infrared active, arises from translations involving two H2O molecules that are restricted by the hydrogen bond between them, i.e., the vibrational restoring force involves the O-H...O interaction, and the translation occurs along the O-H...O direction. Thus, a decrease in the integrated Raman intensity of the 170/cm band with temperature rise means that the concentration of O-H...O units in pure water, for example, has decreased. In general, the OH stretching region of water is sufficiently sensitive to the details of the interactions with various solutes that it must virtually be treated on a case by case basis. In contrast, the total O-H...O concentration of a solution, compared to the corresponding concentration in pure water, is a reliable measure of structure making or structure breaking, and one which is devoid of fine mechanistic details. It is therefore of great value, and it is hoped that more general use of the low-frequency Raman techniques described here will be made to determine the overall structure-breaking or structure-making effects of solutes in water. (See also W88-01593) (Lantz-PTT)
W88-01595

DIFFRACTION TECHNIQUES FOR THE STUDY OF PURE WATER AND AQUEOUS SOLUTIONS,
Institut Max von Laue - Paul Langevin, Grenoble (France).
J. E. Enderby, and G. W. Neilson.
IN: Biomembranes, Part O, Protons and Water: Structure and Translocation. Methods in Enzymology, Volume 127. Academic Press, Inc., Orlando, FL. 1986. p 319-328, 6 fig, 3 tab, 8 ref.

Descriptors: *Diffraction, *Chemical analysis, *Aqueous solutions, *Water properties, Molecular structure, Cations, Anions.

In terms of ion and atomic centers, there are correlation functions which can be conveniently grouped under three headings: (1) water-water interactions represented by correlations between O and O, O and H, and H and H; (2) ion-water interactions represented by M and O, M and H, X and O, and X and H; and (3) ion-ion interactions represented by M and M, X and X, and M and X. A microscopic theory of ions in solution would ideally call for an understanding of all correlation functions and how they evolve with time. As drawn, the ions and water molecules appear to be more or less at random, but closer scrutiny shows that there is a distinct tendency for the oxygen atom in the water molecule to point toward the positively charged M(+) ion, the cation. Similarly, there is a tendency, though somewhat less marked, for the hydrogen part of the molecule to align itself with the X(-) ion, the anion. This leads to the idea of a coordination complex in which positive or negative ions are bonded to water molecules with the generic formula M(H2O)sub to the Z(+) power or X(H2O) sub n to the Z(-) power. Such complexes will be characterized by lifetime, structure, formula, transport coefficients, and so on. The difficulty in deducing these characteristics is that these properties are generally masked by effects due to the nonbonded water; for example, X-ray or neutron diffraction patterns contain contributions from all the correlation functions mentioned above, and even for a concentrated solution, the effects of coordination complexes may be too small to be determined reliably. To overcome these difficulties as far as structure is concerned, diffraction techniques combined with the method of differences must be used. (See also W88-01593) (Lantz-PTT)
W88-01597

2. WATER CYCLE

2A. General

SUBMODELS OF GROUNDWATER-SURFACE WATER INTERACTION FOR THE ANALYSIS OF REGIONAL WATER POLICIES IN OPEN-PIT LIGNITE MINING AREAS,
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
K. Tiemer, B. Konig, I. Michels, and S. Kaden.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 849-860, 7 fig, 5 ref.

Descriptors: *Surface-groundwater relations, *Water policy, *Mine drainage, *Model studies, *Groundwater management, *East Germany, Lignite mines, Infiltration, Hydrologic budget, Flow profiles, Hydrologic models.

An approach to groundwater-surface water submodels for the analysis of regional water policies in a test region in the German Democratic Republic is described. In open-pit lignite mining areas, processes of infiltration and exfiltration between ground- and surface water resources are frequently an important factor for the regional water balance. For example, infiltration losses of surface water caused by mine dewatering reduce the water supply for downstream water users and increase the groundwater pumpage for dewatering. For the analysis of regional water policies in lignite mining areas such processes have to be considered carefully. The submodels to be developed have to reflect the natural processes sufficiently accurately but should be as simple as possible. An introductory methodological background is given and ways for model reduction based on computations with com-

prehensive flow models are discussed. The proposed methodological approaches are demonstrated for the development of a submodel for the management of remaining pits in lignite mining areas. (See also W88-01554) (Author's abstract)
W88-01575

GENERALIZED KINEMATIC CATCHMENT MODEL,
Newcastle Univ. (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W88-01702

DEVELOPMENT OF AN EXPERT SYSTEM FOR THE ANALYSIS OF URBAN DRAINAGE USING 'SWMM' (STORM WATER MANAGEMENT MODEL),
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 6A.
W88-01759

STATISTICAL EVALUATION OF DRAINAGE TREATMENTS IN SIMPLE FIELD TRIALS WITH SPECIAL REFERENCE TO FORMER OPENCAST COAL MINING LAND,
University Coll. of Wales, Llanelly. Field Lab.
For primary bibliographic entry see Field 2G.
W88-01923

FIELD DRAINAGE EXPERIMENTS AND DESIGN ON FORMER OPENCAST COAL MINING LAND,
University Coll. of Wales, Llanelly. Field Lab.
For primary bibliographic entry see Field 2G.
W88-01924

DIMENSIONING OF COMBINED SEWER SYSTEM DETENTION BASINS BY LONG TERM SIMULATION OF STORM WATER RUNOFF,
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft, Hydrologie und Landwirtschaftlichen Wasserbau.
For primary bibliographic entry see Field 5D.
W88-01952

SYSTEM MODELLING OF THE INTERACTION BETWEEN SURFACE AND GROUND WATERS IN PROBLEMS OF HYDROLOGY,
Institut Gidrodinamiki, Novosibirsk (USSR).
O. F. Vasiliev.
Hydrological Sciences Journal HSJODN, Vol. 32, No. 3, p 297-311, September 1987. 4 fig, 36 ref.

Descriptors: *Surface-groundwater relations, *Hydrologic models, *Model studies, Mathematical models, Hydrological systems, Flow profiles, Geohydrology, Water management, Mathematical studies.

A survey of the mathematical (quantitative) modeling of the interaction between surface water and groundwater is presented. Besides describing the existing approach to such modeling and the main difficulties in its realization, a brief review of the principal works on the subject under consideration, including Soviet ones is presented. The construction of such coupled models requires the development of methods of conjunction between models which represent surface and subsurface flows, which describe the different processes of water transfer and transformation constituting the hydrological cycle, and which include the different components of hydrological, hydrogeological and water management systems (water bodies, streams, aquifers, etc.). Such models are of different complexities and have different dimensionality in space variables. The characteristic time scales of transient processes for surface water and groundwater differ greatly, and this is of profound importance in the numerical modelling of their interconnected motion. (Author's abstract)
W88-01962

SHORT-RANGE RUNOFF FORECASTING FOR THE RIVER RHINE AT RHEINFELDEN: EXPERIENCES AND PRESENT PROBLEMS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Geographisches Inst.
For primary bibliographic entry see Field 2E.
W88-01968

APPLICATION OF INFILTRATION EQUATIONS TO A CATCHMENT WITH LARGE SPATIAL VARIABILITY IN INFILTRATION,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
R. Berndtsson.
Hydrological Sciences Journal HSJODN, Vol. 32, No. 3, p 399-413, September 1987. 5 fig, 4 tab, 31 ref.

Descriptors: *Infiltration, *Mathematical equations, *Surface-groundwater relationships, *Catchment areas, Horton equations, Philip equation, Semiarid lands, Rainfall-runoff relationships, Statistical analysis, Tunisia, Storm runoff, Mathematical analysis.

The infiltration equations according to Horton and Philip were applied to 52 double-ring infiltrometer tests performed in a small semiarid catchment in northern Tunisia. Spatial variability in infiltration properties was analyzed with regard to the coefficients of the two equations. The Horton equations could not be fitted in a meaningful way to the measurements in about 17 and 6% of the cases. In the least-square fitting, the constant depending mainly on soil and vegetation (alpha) and initial infiltration rate at t = 0 (i sub o) coefficients for these cases yielded infinite or nearly infinite values. Similarly, the least-square fitting of Philip's equations often yielded negative coefficients (37% of the cases). The coefficients of these tests had to be evaluated graphically. The Horton equations displayed a slightly better fit to observed infiltration as compared with those of Philip. Exponential frequency distribution functions seem to agree reasonably well with observed frequency distributions of infiltration coefficients. Analysis of spatial differences showed that nose, slope, hollow, and urban areas display different infiltration mechanisms and infiltration rates. Overland flow may occur on saturated areas, which vary greatly in size. Saturated overland flow may also occur in semiarid or arid areas mainly in hollow regions, but storm runoff generating processes are made more complex by the occurrence of hard surface soils in nose areas with low infiltration rates, as indicated above. Overland flow according to Horton is likely to appear frequently in these areas when rainstorms occur as short bursts of high intensity. However, more detailed field studies are needed to reveal statistically significant differences between geomorphological zones and occurrences of, for example, runoff between different geomorphological zones. (Lantz-PTT)
W88-01969

INVESTIGATION OF GROWTH INSTABILITIES OF THE ICE-WATER INTERFACE BY LIGHT SCATTERING SPECTROSCOPY,
California Univ., Davis.
For primary bibliographic entry see Field 2C.
W88-02275

URBAN HYDROLOGY: A MULTIDISCIPLINARY PERSPECTIVE,
For primary bibliographic entry see Field 4C.
W88-02326

RELATIONSHIP BETWEEN SUMMER-SEASON RAINFALL EVENTS AND LAKE-SURFACE AREA,
Nebraska Univ.-Lincoln. Conservation and Survey Div.
D. C. Rundquist, M. P. Lawson, L. P. Queen, and R. S. Cerveny.
Water Resources Bulletin WARBAQ, Vol. 23, No. 3, p 493-508, June 1987. 9 fig, 6 tab, 18 ref.

Descriptors: *Rainfall, *Lakes, *Surface area, *Seasonal variation, *Rainfall-runoff relationships, *Surface-groundwater relations, *Temporal variation, Sandhill lakes, Statistics, Precipitation.

The use of Landsat digital data and automated processing procedures to monitor fluctuations in lake-surface areas of selected Sandhills lakes is described objectives. The fluctuation patterns at the Crescent and Valentine National Wildlife Refuges are statistically different from one another despite the fact that the data revealed a general simple positive relationship between lake size and variability at both sites. The pronounced difference in lake-size reaction to precipitation at the two sites is considered important, although it is well beyond the scope of the current work to consider specific reasons for the difference. At the Crescent site, a good correlation between lake-surface area and precipitation occurring over the previous 45 days was found. The pattern of temporal relationships between precipitation and lake size tends to be repeatable and somewhat constant at the Crescent site. At Valentine, no clear-cut correlational pattern emerged. (Alexander-PTT)
W88-02389

DIMENSIONLESS SOLUTION OF LAG TIME FOR DIVERGING SURFACE,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
N. Agiralioglu.
Nordic Hydrology NOHYBB, Vol. 18, No. 1, p 59-62, 1987. 2 fig, 4 ref.

Descriptors: *Kinetics, *Wave theory, *Numerical analysis, *Lag time, *Rainfall-runoff relationships, *Kinematic waves, *Urban runoff, *Surface area, *Catchment areas, Urban areas, Fluid friction, Flow, Rural areas.

Using the kinematic wave theory of runoff formation, a dimensionless expression is obtained, and solved numerically in order to estimate the surface-water lag time for diverging surfaces. The findings show that the dimensionless lag time, which is the ratio of lag time for diverging surface to that of plane surface, ranges from 1 to 0.5 depending on the degree of divergence and friction formula used. The results can be used easily and reliably for all ranges of the geometric parameter for both urban and rural catchments. (Author's abstract)
W88-02442

2B. Precipitation

COLORADO RIVER AUGMENTATION DEMONSTRATION PROGRAM.
Bureau of Reclamation, Montrose, CO.
For primary bibliographic entry see Field 3B.
W88-01609

INFLUENCE OF RAINFALL DISTRIBUTION IN NUMERICAL SIMULATION OF EVAPOTRANSPIRATION FROM A MULTILAYER MODEL PINE CANOPY,
Leeds Univ. (England). School of Geography.
For primary bibliographic entry see Field 2D.
W88-01696

CLIMATOLOGY OF STORM PRECIPITATION IN THE DETROIT-WINDSOR AREA,
McMaster Univ., Hamilton (Ontario).
S. J. Vermette.
The Canadian Geographer CNGGAR, Vol. 30, No. 3, p 260-264, Fall 1986. 6 fig, 1 tab, 19 ref.

Descriptors: *Precipitation, *Storms, *Urban areas, *Precipitation patterns, Spatial distribution, Detroit, Windsor, Distribution, Urban effects, Lakes, Gages, Rain gages.

The measurement of precipitation from intense storms is difficult because they take place in a limited geographic area and because of their variability. The dense network of precipitation gages in Detroit, which was established as a result of the occurrence of a severe storm and subsequent flooding in the early 1960s, was used to discern precipitation patterns from a number of storms over an

extended period of time. The spatial pattern of storm precipitation was documented over a ten-year period (1974-1983) and possible urban influence was determined. An increase of storm precipitation in and downwind of the Detroit-Windsor area was documented and the spatial characteristics suggested an urban influence, lake influence, or combination of both. The contributing factors and influences that explain the anomaly presented by rainfall data from gages at Detroit and Windsor weather offices not representing storm rainfall in and downwind of these cities could not be examined with the existing network. (Wood-PTT)
W88-01926

ACIDIC DEPOSITION TO FORESTS: THE 1985 CHEMISTRY OF HIGH ELEVATION FOG (CHEF) PROJECT,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5B.
W88-02003

DECISION-ANALYTIC STUDY OF THE JOINT VALUE OF SEASONAL PRECIPITATION AND TEMPERATURE FORECASTS IN A CHOICE-OF-CROP PROBLEM,
Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences.
D. S. Wilks, and A. H. Murphy.
Atmosphere-Ocean ATOCDA, Vol. 24, No. 4, p 353-368, December 1986. 3 fig, 3 tab, 15 ref. NOAA Grant NA82AA-D-00042 and NSF Grant ATM-8507495.

Descriptors: *Weather forecasting, *Economic aspects, *Crop forecasting, *Decision making, *Planning, *Corn, *Wheat, Food crops, Weather, Value.

A static decision-analytic method is used to investigate the economic value of bivariate - precipitation and temperature - seasonal forecasts of the form currently issued by the U.S. National Weather Service. This method is applied to a corn versus spring wheat choice-of-crop decision-making problem by considering a transect of four counties across the northwestern margin of the North American corn belt. Numerical results indicate that seasonal forecasts of current quality can be of appreciable value (> or = $1/ha) for some locations when the optimal action chosen on the basis of climatological information is only marginally preferred to another action. Increases in forecast value follow from hypothetical increases in the quality of both the precipitation and temperature components of the forecasts in the spring wheat region, whereas forecast value increases primarily as a function of the quality of the precipitation forecasts alone in the corn belt region. The results are very sensitive to absolute and relative crop prices. (Author's abstract)
W88-02004

CALIBRATION OF AN AIRBORNE LYMAN-ALPHA HYGROMETER AND MEASUREMENT OF WATER VAPOR FLUX USING A THERMOELECTRIC HYGROMETER,
California Univ., Irvine. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 7B.
W88-02043

NEW TECHNIQUE FOR THE STUDY OF CLOUD MICROSTRUCTURE,
National Center for Atmospheric Research, Boulder, CO. Research Aviation Facility.
For primary bibliographic entry see Field 7B.
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DIRECT METHOD FOR DERIVING DROP-SIZE DISTRIBUTION AND VERTICAL AIR VELOCITIES FROM VHF DOPPLER RADAR SPECTRA,
Kyoto Inst. of Tech. (Japan). Dept. of Electrical Engineering.
For primary bibliographic entry see Field 7B.
W88-02045

INFLUENCE OF RAINGAGE INTEGRATION TIME ON MEASURED RAINFALL-INTENSITY DISTRIBUTION FUNCTIONS,
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For primary bibliographic entry see Field 7B.
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Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
For primary bibliographic entry see Field 7B.
W88-02047

METEOR: AN ARTIFICIAL INTELLIGENCE SYSTEM FOR CONVECTIVE STORM FORECASTING,
Alberta Univ., Edmonton. Dept. of Computing Science.
For primary bibliographic entry see Field 7B.
W88-02048

94-GHZ DOPPLER RADAR FOR CLOUD OBSERVATIONS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
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TECHNIQUE TO MEASURE ENTRAINMENT IN CLOUD BY DUAL-POLARIZATION RADAR AND CHAFF,
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
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Clemson Univ., SC. Dept. of Physics and Astronomy.
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W88-02051

FURTHER DISCUSSION ON DERIVING DROP-SIZE DISTRIBUTION AND VERTICAL AIR VELOCITIES DIRECTLY FROM VHF DOPPLER RADAR SPECTRA,
Kyoto Inst. of Tech. (Japan). Dept. of Electrical Engineering.
For primary bibliographic entry see Field 7B.
W88-02052

FIELD EVALUATION OF A DUAL-CHANNEL MICROWAVE RADIOMETER DESIGNED FOR MEASUREMENTS OF INTEGRATED WATER VAPOR AND CLOUD LIQUID WATER IN THE ATMOSPHERE,
Bureau of Reclamation, Auburn, CA. Sierra Cooperative Pilot Project.
For primary bibliographic entry see Field 7B.
W88-02053

REDUCTION OF ERRORS CAUSED BY BRIGHT BANDS IN QUANTITATIVE RAINFALL MEASUREMENTS MADE USING RADAR,
Royal Signals and Radar Establishment, Malvern (England).
For primary bibliographic entry see Field 7B.
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INFLUENCE OF ACID PRECIPITATION ON THE DEVELOPMENT OF ERYSIPHE GRAMINIS DC F. SP. TRITICI MARCHAL (EINFLUSS SAEUREHALTIGER NIEDERSCHLAEGE AUF DIE ENTWICKLUNG VON ERYSIPHE GRAMINIS DC. F. SP. MARCHAL),
Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Mikrobiologie.
For primary bibliographic entry see Field 5C.
W88-02098

SENSITIVITY OF HIGH-ELEVATION STREAMS IN THE SOUTHERN BLUE RIDGE PROVINCE TO ACIDIC DEPOSITION,
Georgia Univ., Athens. Dept. of Sociology and Anthropology.
For primary bibliographic entry see Field 5C.
W88-02377

REGIONAL RAINFALL INTENSITY-DURATION-FREQUENCY CURVES FOR PENNSYLVANIA,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
G. Aron, D. J. Wall, E. L. White, and C. N. Dunn.
Water Resources Bulletin WARBAQ, Vol. 23, No. 3, p 479-485, June 1987. 9 fig, 1 tab, 6 ref. Environmental Resources Research Institute Agreement 80533.

Descriptors: *Design storms, *Rainfall intensity, *Regional analysis, *Pennsylvania, *Statistical analysis, Storms, Rainfall, Distribution.

A statistical analysis of all available continuous hourly and 15-minute duration rainfall records for Pennsylvania was performed to develop and update procedure to estimate design storms. As a result of this study, Pennsylvania was divided into five homogeneous rainfall regions and a set of rainfall intensity-duration curves developed for each region, for return periods of 1 to 100 years and durations ranging from 5 minutes to 24 hours. The PDT-IDF curves were judged to be a better representation of Pennsylvania rainfall than the nationwide TP-40 maps, particularly for storm events of 10-years and lower return periods. The average time distribution of 24-hour storms in Pennsylvania was found to be well represented by the SCS Type II distribution. The Corps of Engineers SPS 24-hour distribution was found to differ appreciably from both the SCS Type II and the Pennsylvania 24-hour storm distribution. For storm durations between 15 and 90 minutes the standard Yarnell intensity-duration curves closely resemble Pennsylvania storm distributions. (Author's abstract)
W88-02387

COMPUTER MODELLING STUDY OF THE CHEMISTRY OCCURRING DURING CLOUD FORMATION OVER HILLS,
UKAEA Atomic Energy Research Establishment, Harwell (England).
For primary bibliographic entry see Field 2K.
W88-02402

POTENTIAL CONTRIBUTION OF SULFATE PRODUCTION IN CUMULUS CLOUD DROPLETS TO GROUND LEVEL PARTICLE SULFUR CONCENTRATIONS,
Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 5B.
W88-02403

THEORETICAL ASSESSMENT OF POLLUTANT DEPOSITION TO INDIVIDUAL LAND TYPES DURING A REGIONAL-SCALE ACID DEPOSITION EPISODE,
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 5B.
W88-02404

OXIDATION OF SO2 IN RAINWATER AND ITS ROLE IN ACID RAIN CHEMISTRY,
Leeds Univ. (England). Dept. of Fuel and Energy.
For primary bibliographic entry see Field 5B.
W88-02405

WET DEPOSITION OF SULFATE AND ITS RELATIONSHIP TO SULPHUR DIOXIDE EMISSIONS,

Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
For primary bibliographic entry see Field 5B.
W88-02406

CONCENTRATION OF TRACE METALS IN PRECIPITATION,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5A.
W88-02407

INFLUENCE OF ALKALINE PARTICULATES ON PH OF CLOUD AND RAIN WATER IN INDIA,
Indian Inst. of Tropical Meteorology, Poona.
For primary bibliographic entry see Field 2K.
W88-02408

CHEMICAL COMPOSITION OF PRECIPITATION AT MARION ISLAND (SUB-ANTARCTIC),
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Botany.
For primary bibliographic entry see Field 2K.
W88-02410

DEPOSITION OF NITRATE-N AND SULFATE-S BY PRECIPITATIONS IN SCHLESWIG-HOLSTEIN,
Kiel Univ. (Germany, F.R.). Inst. fuer Pflanzenernaehrung und Bodenkunde.
E. Schnug, and F. Holz.
Atmospheric Environmental ATENBP, Vol. 21, No. 5, p 1235-1241, May 1987. 7 fig, 2 tab, 17 ref.

Descriptors: *Deposition, *Nitrates, *Sulfates, *Precipitation, *Nutrients, *Atmospheric chemistry, *Water chemistry, Nitrogen, Sulfur, Rainfall, Plants, Agriculture.

In order to quantify the atmospheric nitrate and sulfate deposition and to investigate factors related to the variablity of deposition during 1983 and 1984, precipitation samples from five different meteorological stations in Schleswig-Holstein (Northern Germany) were collected in weekly intervals, using the bulk-sample method. The average element depositions in kg/ha/a were: 20 for S and 5.5 for N in List (North Sea Island Sylt) and Schleswig, 12 for S and 4.7 for N in Kiel, 16 for S and 4.3 for N in Luebeck and 18 for S and 4.2 for N in Quickborn near Hamburg. N and S concentrations showed a close relationship to the amount of precipitation and the following functions for the estimation of nitrate-N and sulfate-S deposition in Schleswig-Holstein could be derived: (x = precipitation in mm/a, y = N or S deposition in kg/ha/a) NO3-N: $y + 0.003x + 2.29$; SO4-S: $y = 0.014x + 4.71$. According to these relationships most of the element deposition occurred during atmospheric conditions of predominating winds from the west. Especially in the case of S, atmospheric deposition is the only external source of S supply for plants on many agricultural soils. Sometimes the low sulfur input is not sufficient to cover the requirements of agricultural crops in Schleswig-Holstein. Due to the negative S balance in many soils, future increase of S deficiency is expected. (Author's abstract)
W88-02411

RESPONSE OF TWO WESTERN CANADIAN CONIFERS TO SIMULATED ACIDIC PRECIPITATION,
Saskatchewan Research Council, Saskatoon.
For primary bibliographic entry see Field 5C.
W88-02464

RESPONSE OF TWO ADIRONDACK WATERSHEDS TO ACIDIC DEPOSITION,
Electric Power Research Inst., Palo Alto, CA. Environmental Assessment Dept.
For primary bibliographic entry see Field 5C.
W88-02465

DETERMINATION OF ORGANIC ACID ANIONS IN PRECIPITATION BY ION CHROMATOGRAPHY EXCLUSION,
Illinois State Water Survey Div., Champaign. Analytical Chemistry Lab.
For primary bibliographic entry see Field 5A.
W88-02469

RESISTANCE OF THE CARIBOU LICHEN CLADINA STELLARIS (OPIZ.) BRODO TO GROWTH REDUCTION BY SIMULATED ACIDIC RAIN,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W88-02479

ACIDIFICATION OF NOVA SCOTIA LAKES: III ATMOSPHERIC DEPOSITION OF SO4 AND NO3 AND EFFECTS ON URBAN AND RURAL LAKES,
Nova Scotia Dept. of the Environment, Halifax.
For primary bibliographic entry see Field 5B.
W88-02484

2C. Snow, Ice, and Frost

METHODS FOR THE STUDY OF WATER IN ICE PHASES,
Institut Max von Laue - Paul Langevin, Grenoble (France).
For primary bibliographic entry see Field 1A.
W88-01596

NEW METHOD FOR CALCULATING FROST HEAVE INCLUDING SOLUTE EFFECTS,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
J. W. Cary.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1620-1624, August 1987. 7 fig, 17 ref.

Descriptors: *Frost heaving, *Soil water, *Mathematical studies, Calculation, Frost, Frost thrusting, Solutes, Solute effects, Freezing, Soil physical properties, Soil temperature, Permeability coefficient, Mathematical equations.

A numerical method is presented that models the coupled flow of heat, water, and solutes as unsaturated soil freezes. Input requires a general knowledge of the physical properties of the soil as well as the initial water, temperature, and solute distributions. Soil surface temperature or the heat flux across the soil surface drives the model. The method reproduces the observations of temperature and water movement in two non-saline field studies previously reported in the literature. The analysis shows that increasing solutes can decrease frost heaving by reducing water flow to the ice lens. A method for measuring the unsaturated hydraulic conductivity in frozen soil is proposed. (Author's abstract)
W88-01693

METHOD OF PRODUCING LARGE BODIES OF ICE,
For primary bibliographic entry see Field 8F.
W88-01781

CHEMICAL COMPOSITION OF FRESH SNOW ON MOUNT EVEREST,
Wyoming Univ., Laramie. Dept. of Geography and Recreation.
For primary bibliographic entry see Field 5A.
W88-01860

USE OF CURRENT METERS FOR CONTINUOUS MEASUREMENT OF FLOWS IN LARGE RIVERS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2E.
W88-01914

SNOW COVER DATA MANAGEMENT: THE ROLE OF WDC-A FOR GLACIOLOGY,
World Data Center A for Glaciology, Boulder, CO.
R. G. Barry, and R. L. Armstrong.
Hydrological Sciences Journal HSJODN, Vol. 32, No. 3, p 281-295, September 1987. 4 fig, 4 tab, 38 ref. NSF Grant No. SES-85-18586 and NASA Grant No. NAGW641.

Descriptors: *Snow cover, *Data management, *Glaciology, Snow accumulation, Snow pack, Research needs, Data acquisition, Water supply, Forecasting.

Snow cover in the temperate regions of the world is one of the most important renewable resources. The use of snow for winter recreation, for irrigation and municipal water supplies, for the generation of hydroelectric power, and for soil water replenishment, is well established. A wide range of technologies has the potential to deal with hydrological problems such as flood forecasting and water yield, as well as the forecasting of severe winter storms. However, success will depend on improved access to unified and comprehensive snow cover data sets, both as real-time input for prediction methods as well as ground-truth for subsequent model analysis and satellite data verification. Up to now the study of snow cover conditions has been carried out on a local or regional scale. Research is hindered because the data are not even homogeneous in different countries. As a contribution to the assembly of such data, WDC-A for Glaciology has initiated an inventory on the observational methods and variables measured. Further, a Crysopheric Data Management System is being developed which will enable snow cover maps to be constructed, for example, using passive microwave data from the US DMSP satellite. (Lantz-PTT)
W88-01961

RELATIONSHIP BETWEEN WINTER LAKE COVER, RADIATION RECEIPTS AND THE OXYGEN DEFICIT IN TEMPERATE LAKES,
National Hydrology Research Inst., Saskatoon (Saskatchewan).
For primary bibliographic entry see Field 2H.
W88-02005

INVESTIGATION OF GROWTH INSTABILITIES OF THE ICE-WATER INTERFACE BY LIGHT SCATTERING SPECTROSCOPY,
California Univ., Davis.
Y. Yeh.
Available from the National Technical Institute Service, Springfield, VA 22161, as PB87 218889/AS, price codes: A03 in paper copy, A01 in microfiche. Final Report, September 1, 1979 - September 30, 1982. 40 p, 15 fig, 2 tab, 36 ref. OWRT Project C-90127-S(1). Grant No. 14-34-0001-9435.

Descriptors: *Ice, *Physical properties, *Light scattering spectroscopy, *Ice-water interfaces, Ice formation, Crystal growth, Light, Model studies, Supercooling.

The growth of a pure single crystal of ice into its own melt under a temperature gradient leads to enhanced scattering of light at the ice-water interface. This anomalously intense scattering of light develops when the crystal growth velocity exceeds 0.6 micrometers/sec. Even though the scattering phenomenon occurs as soon as the dynamic stationary state interface has developed, the ice phase which has been overtaken by this surface exhibits no anomalous scattering. Experiments have been conducted to measure the angular dependence of decay time associated with scattering and the long term development of this interfacial phenomenon. Scattering does not occur in the liquid phase under given supercooling and temperature gradient if the interface is absent. Substances which can disrupt interfacial ice growth have been selected by detailed investigations of their ice growth inhibition capabilities. A model postulating that this phenomenon is related to the growth and dissipation of spontaneous surface defects has been explored. (Author's abstract)

W88-02275

SEQUENTIAL SAMPLING OF SNOW IN A RURAL AREA. EXPERIMENTATION AND IDENTIFICATION OF THE ACIDIFYING AGENTS,
Paris-7 Univ. (France). Lab. de Physico-Chimie de l'Atmosphere.
For primary bibliographic entry see Field 5B.
W88-02409

MICROWAVE REMOTE SENSING OF SNOWPACK PROPERTIES: POTENTIAL AND LIMITATIONS,
Northern Forest Research Centre, Edmonton (Alberta).
For primary bibliographic entry see Field 7B.
W88-02438

IN SITU STUDIES AND EXPERIMENTS OF THE ECOTOXICOLOGY OF FOUR METALS (CD, PB, CU, ZN) ON ALGAE AND GRAZING MOLLUSKS (GASTROPODA) (ETUDES IN SITU ET EXPERIMENTALES DE L'ECOTOXICOLOGIE DE QUATRE METAUX (CD, PB, CU, ZN) CHEZ DES ALGUES ET DES MOLLUSQUES GASTEROPODES BROUTEURS),
Nantes Univ. (France). Centre de Dosage des Elements Traces.
For primary bibliographic entry see Field 5C.
W88-02476

BEHAVIOR OF HYDROPHOBIC, ORGANIC MICROPOLLUTANTS IN DIFFERENT KARST WATER SYSTEMS: I. TRANSPORT OF MICROPOLLUTANTS AND CONTAMINANT BALANCES DURING THE MELTING OF SNOW,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
For primary bibliographic entry see Field 5B.
W88-02480

2D. Evaporation and Transpiration

INFLUENCE OF RAINFALL DISTRIBUTION IN NUMERICAL SIMULATION OF EVAPOTRANSPIRATION FROM A MULTILAYER MODEL PINE CANOPY,
Leeds Univ. (England). School of Geography.
T. A. Cooper, and J. G. Lockwood.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1645-1656, August 1987. 8 fig, 3 tab, 31 ref, append. Commission of the European Communities Contract CL108-UK(H).

Descriptors: *Evapotranspiration, *Rainfall distribution, *Simulation analysis, *Model studies, *Pine trees, *Forest hydrology, Canopy, Hydrologic budget, Mathematical equations, Radiation, Surface water, Drainage, Evaporation rate, Water yield, Precipitation, Rainfall intensity.

A multilayer canopy model is used to simulate the water balance of a pine forest. The role of advected energy in sustaining evapotranspiration from tall canopies in low-radiation environments is reproduced. The surface water balance of temperate forested areas is not necessarily dominated by evapotranspiration in conditions of high radiation receipt. Interception loss is greater where the rainfall regime consists of shorter events, since long-duration storms tend to fully saturate the canopy. The achievement of the potential evaporation rate and the onset of drainage then combine to limit interception loss totals. This result is important in considering the possible effect of climatic change on water resources. Catchment yield may be as sensitive to the temporal distribution of rainfall as to seasonal or annual totals. (Author's abstract)
W88-01696

ALPHA, BETA, GAMMA OF EVAPORATION FROM SALINE WATER BODIES,
Woodward-Clyde Consultants, Walnut Creek, CA.
A. M. Salhotra, E. E. Adams, and D. R. F. Harleman.
Water Resources Research WRERAQ, Vol. 23, No. 9, p 1769-1774, September 1987. 2 fig, 5 tab, 11 ref.

Descriptors: *Evaporation, *Saline water, *Saline lakes, *Lake evaporation, *Model studies, Evaporation rate, Vapor pressure, Surface water, Surface water temperature, Mathematical models, Mathematical equations, Dead Sea, Evaporation pans, Mediterranean Sea, Salinity.

Evaporation from a saline body is less than that from a freshwater body because of two factors: a decrease in saturation vapor pressure and a partially compensating increase in water surface temperature. These factors are quantified by analyzing field data for eight evaporation pans containing solutions with different salinities and ionic compositions A large saline lake (Dead Sea) is also analyzed using a one-dimensional numerical model with coupled heat, salt, water, and mechanical energy balances. Further, the use of experiments involving evaporation pans, to study the effect of salinity on lake evaporation, is discussed in light of the fact that the two water bodies have different wind speed functions and hence different temperature feedback effects. Finally, data on the direct measurement of the saturation vapor pressure from mixtures of Mediterranean and Dead Sea waters are presented and compared with results from the analyses of the evaporation pan data. (Author's abstract)
W88-01917

ENTROPY BALANCE IN LAKE BIWA,
Osaka Univ. (Japan). Dept. of Physics.
For primary bibliographic entry see Field 2H.
W88-01979

USING CROP YIELD AND EVAPOTRANSPIRATION RELATIONS FOR REGIONAL WATER REQUIREMENT ESTIMATION,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih.
Water Resources Bulletin WARBAQ, Vol. 23, No. 3, p 435-442, June 1987. 2 fig, 5 tab, 23 ref.

Descriptors: *Model studies, *Biomass, *Evapotranspiration, *Food crops, *Water demand, *Water use, *Crop yield, Prediction, Planning, Agriculture, Water resources.

Values of dry biomass of corn, sugarcane, sorghum, rice, taro, millet, cotton, cowpeas, soybeans, and velvet beans as related to the evapotranspiration (ET) were studied. The linear regression model was sufficiently accurate to establish the crop dry biomass and ET relations. A water-use efficiency index (WUE), which is defined as the additional crop dry biomass per unit ET, is used in this study. The WUE were grouped into high, medium, and low categories. The WUE varied from greater than 35 kg/ha/mm for the high category, between 15 and 35 kg/ha/mm for the medium category, and less than 15 kg/ha/mm for the low category. Application of the established model to the Everglades Agricultural Area, Florida, showed that the regional ET can be predicted from the known regional crop yields. The crop yield and ET relations could be used as a potential tool to improve water resources planning and management practices for crop production. (Author's abstract)
W88-02382

2E. Streamflow and Runoff

FEASIBILITY OF ASSIGNING A PROBABILITY TO THE PROBABLE MAXIMUM FLOOD.
Interagency Advisory Committee on Water Data, Reston, VA. Hydrology Subcommittee.
1986. 79 p, 2 fig, 74 ref, 4 append.

Descriptors: *Probable maximum precipitation, *Flood forecasting, *Probable maximum flood, *Data interpretation, *Precipitation, Flooding, *Statistical analysis, Probabilistic process, Paleohydrology, Floods, Bayesian methods, Flood frequency.

A Work Group was formed in mid-1984 by the Hydrology Subcommittee of the Interagency Advisory Committee on Water Data to investigate two specific questions: Is it within the state of the art to calculate the probability of the probable maximum flood (PMF) within definable confidence or error bounds; If the probability of the PMF cannot be defined, how far out on the probability scale can flood probability be determined within definable confidence or error bounds. The Work Group conducted a survey of over 230 papers and reports from both technical journals and project reports of engineering studies pertaining to the broad topic of large flood events. The statistical literature and this study emphasize the peak discharge of floods, however, volume and duration estimates are sometimes of interest, and the same considerations that prevent assessment of the accuracy of peak flow frequency estimates also apply to volume and duration estimates. The methods found in the literature were separated into five categories: (1) extrapolation of a frequency curve based on gaged records; (2) regional analyses; (3) joint probability analyses; (4) paleohydrologic analyses; and (5) Bayesian analyses. The Work Group's conclusions about defining the probability of the PMF as based on a review of the literature are summarized as follows: (1) It is not within the state of the art to calculate the probability of PMF-scale floods within definable confidence or error bounds; (2) There is no definable point on the probability scale at which it becomes impossible to define error bounds on flood magnitude and probability estimates. Rather, an analysis displays a gradual transition from common place events, whose estimation errors can be defined by statistical random-sampling theory, to unprecedented events, whose errors cannot be defined. Many professionals believe this transition begins at recurrence intervals of about twice the record length and is complete by recurrence intervals in the general area of about 1000 years. The Work Group finds on reason to contradict these general perceptions. (Lantz-PTT)
W88-01612

ST. MARYS RIVER, MICHIGAN: AN ECOLOGICAL PROFILE,
National Wetlands Research Center, Slidell, LA.
W. G. Duffy, T. R. Batterson, and C. D. McNabb.
Biological Report 85(7.10), Mary 1987. 138 p, 71 fig, 57 tab, 220 ref.

Descriptors: *St. Marys River, *Michigan, *Ecology, Rivers, Physical properties, Chemical properties, Ecosystems, Food chains.

St. Marys River, the single outlet from Lake Superior, flows between Michigan and Ontario and has formed the International Border between the United States and Canada since 1783. Although the riverbed and a major rapids system have been modified to accommodate commercial navigation and for hydroelectric generation, the St. Marys River retains more of its biological and physicochemical integrity than any other Laurentian Great Lakes connecting channel. This oligotrophic lake's cold, well-oxygenated water contributes > 90% of the river's annual flow and has a major influence on the evolution of its biological communities. This monograph reviews the published and unpublished ecological information available for the St. Marys River. The authors begin by reviewing the geologic history, human exploration, and settlement of the region, then proceed to a description of the physical and chemical characteristics of the river. The third chapter describes the biological communities presently inhabiting the river. A fourth chapter synthesizes ecological relationships within the river, emphasizing detrital food webs and trophic interactions. In the final chapter, anthropogenic influences on the river ecosystem are reviewed and various natural resource management strategies suggested. (Author's abstract)
W88-01660

RESPONSE TO AN EXOTIC HABITAT BY ARID RIPARIAN BREEDING BIRDS ALONG AN ELEVATIONAL GRADIENT,
Arizona State Univ., Tempe. Center for Environmental Studies.
W. C. Hunter.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB87-202032, A06 in paper copy. 91 p, 7 fig, 11 tab, 48 ref, 5 append. Purchase Order No. 5-PG-32-16680.

Descriptors: *Riparian waters, *Riparian land, *Arid regions, *Breeding birds, *Arizona, *Gila River, Species diversity, Riparian vegetation, Trees, Ecological distribution, Birds.

Differences in bird species occurrence in salt cedar (Tamarix chinensis) habitats have been noted among southwestern rivers in previous studies. Four study areas were established along the Gila River from Yuma to Safford, Arizona to further delineate any existing trends in bird use of salt cedar. Salt cedar, cottonwood (Populus fremontii), willow (Salix gooddingii), and honey mesquite (Prosopis glandulosa) habitats were surveyed to determine bird-habitat relationships at each study area. Total numbers of species and individuals (with only 10% doves considered) were similar for all salt cedar stands. However, species composition differed greatly in their respective numbers at each salt cedar stand. Generally, midsummer breeding species obligated to riparian habitats increased their use of salt cedar from west to east (from low to high elevation). Conversely, most permanent resident species breeding during spring and early summer decreased their use of salt cedar from west to east. Bird groups most clearly demonstrating this trend were: (1) riparian obligative, migratory, midsummer breeders and (2) riparian facultative, permanent residents from desert habitats. (Author's abstract)
W88-01668

ESTIMATING THE UPPER TAIL OF FLOOD FREQUENCY DISTRIBUTIONS,
Interstate Commission on the Potomac River Basin, Rockville, MD.
J. A. Smith.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1657-1666, August 1987. 3 fig, 3 tab, 25 ref, append.

Descriptors: *Flood frequency, *Flood recurrence interval, *Seasonal distribution, *Annual distribution, *Estimating equations, *Mathematical studies, *Potomac, Estimating, Floods, Flood peak, Model studies, Potomac River, Mathematical equations.

Procedures for estimating recurrence intervals of extreme floods are developed. The estimation procedures proposed differ from standard procedures in that only the largest 10-20% of flood peaks are explicitly used to estimate flood quantiles. Quantile estimation procedures are developed for both annual peak and seasonal flood frequency distributions. The underlying model of flood peaks is a marked point process (T sub j super i, Z sub j super i), where T sub j represents time of occurrence of the jth flood during year i and the mark Z sub j super i represents magnitude of the flood peak. Results from the extreme value theory are used to parameterize the upper tail of flood peak distributions. Quantile estimation procedures are applied to the 92-year record of flood peaks from the Potomac River. Results suggest that Potomac flood peaks are bounded above. The estimated upper bound is only 20% larger than the flood of record. (Author's abstract)
W88-01697

GENERALIZED KINEMATIC CATCHMENT MODEL,
Newcastle Univ. (Australia). Dept. of Civil Engineering.
W. G. Field, and B. J. Williams.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1693-1696, August 1987. 2 fig, 10 ref.

Descriptors: *Catchment areas, *Channels, *Kinematic wave theory, *Rainfall-runoff relationships, *Model studies, *Subcatchment networks, Mathematical studies, Mathematical equations, Rainfall, Water storage, Mathematical models, Finite difference methods, Flood forecasting, Hydraulic models.

A proposed runoff model requires the division of the catchment into a (branched) network of subcatchments or reservoirs. Rainfall on these elements of the model is distributed to a surface or a groundwater storage which, in turn, at differing rates, provides inflow into the channel network. The flows in the channels are simulated by a kinematic wave equation which is solved using an implicit finite difference scheme. Typical parameter estimates for catchments of varying sizes are presented. The model is considered to have particular potential for flood forecasting as well as being a useful adjunct to design. (Author's abstract)
W88-01702

PALEODISCHARGE OF THE LATE PLEISTOCENE BONNEVILLE FLOOD, SNAKE RIVER, IDAHO, COMPUTED FROM NEW EVIDENCE,
Geological Survey, Denver, CO.
R. D. Jarrett, and H. E. Malde.
Geological Society of America Bulletin BUGMA, Vol. 99, No. 1, p 127-134, July 1987. 7 fig, 1 tab, 27 ref.

Descriptors: *Paleohydrology, *Historic floods, *Data interpretation, *Computer models, *Lake Bonneville, *Snake River, *Idaho, Erosion, Flood peak, Floods, Mannings equation, Hydraulic models, Model studies.

The Bonneville Flood resulted from catastrophic outflow from Pleistocene Lake Bonneville about 15,000 yr ago, when the lake overtopped its rim at Red Rock Pass in southeastern Idaho and discharged a vast volume of water down the Snake River. Revised estimates of the paleodischarge, volume, and duration of the Bonneville Flood are, based on new evidence of its height and on current understanding of the amount of lowering of Lake Bonneville. Evidence for the revised height of the flood is derived from the altitude of erosional features and flood deposits at the head of a constricted reach of the Snake River Canyon at the mouth of Sinker Creek, and from the altitudes of flood deposits at several places about 53 km upstream. Using the step-backwater method, it is estimated that peak discharge for the Bonneville Flood through the constricted reach was from 793,000 to 1,020 000 cu m/s and most likely was 935,000 cu m/s. This discharge is 2.2 times the discharge previously reported and is the second largest flood known to have occurred in the world. At this rate of discharge, the shear stress for the flood would have been 2,500 N/sq m, and the unit stream power would have been 75,000 N/m/s, as compared with values of 6 to 10 N/sq m and 12 N/m/s for recent floods on the Mississippi and the Amazon. Other recent studies of the history of Lake Bonneville show that the volume of water released was 4,700 cu km, or about 3 times greater than the volume previously inferred. Although this volume indicates a flood duration of 8 weeks at constant peak discharge, an accurate estimate of the duration would require dam-break modeling at Red Rock Pass. From a dam-break model, flood hydrographs at Red Rock Pass and the hydraulics of the flood wave along the Snake River could be computed. (Author's abstract)
W88-01808

TRANSFORMATION OF LAKE ZOOPLANKTON IN RIVERS,
Akademiya Nauk SSSR, Leningrad. Zoologicheskii Inst.
For primary bibliographic entry see Field 2H.
W88-01818

TWO SIMPLE MODELS FOR ESTIMATING DAILY MEAN WATER TEMPERATURES AND DIEL VARIATIONS IN A DANISH LOW GRADIENT STREAM,
Miljoestyrelsen, Silkeborg (Denmark). Freshwater Lab.
For primary bibliographic entry see Field 2H.
W88-01830

ARE SNAILS IMPORTANT COMPETITORS IN STREAM ECOSYSTEMS,
Utah State Univ., Logan. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 2H.
W88-01831

SUBTIDAL VOLUME EXCHANGE THROUGH THE CHESAPEAKE AND DELAWARE CANAL,
Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 2L.
W88-01858

BIOLOGY OF STREAMS AS PART OF AMAZONIAN FOREST ECOLOGY,
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
I. Walker.
Experientia EXPEAM, Vol. 43, No. 3, p 279-287, March 15, 1987. 3 fig, 4 tab, 33 ref.

Descriptors: *Amazon River basin, *Streams, *Ecosystems, *Forests, Nutrients, Litter, Aquatic animals, Food chains, Invertebrates, Acidic waters, Humic matter.

Data on long term research on the ecology of Central Amazonian forest streams reveal the following basic features: (1) the essential input of nutrients into these waters consists of forest litter and of the fungi that decompose this litter. Consequently, the bulk of the fauna is concentrated in accumulations of submerged litter; (2) nutrients released by the decomposition of this litter do not appear in solution in the stream water, but are tied up throughout in the food web of the aquatic fauna; (3) this food web is relatively robust due to the absence of food specialists in the major channels of energy transfer. One of the staple foods for invertebrate predators consists of chironomid larvae; (4) the degree of acidity and/or the content of dissolved humic substances (more or less black water) has a marked effect on the density and to a lesser extent on the species diversity of the invertebrate fauna, black waters being richer in both; and (5) the annual inundations of the forest in the middle and lower courses of the smaller rivers lead to drastic periodic changes of animal densities, and in some cases to annual periodicity of breeding, as exemplified by a three-year study of shrimp populations in the river 'Tarumazinho'. (Lantz-PTT)
W88-01888

STABILIZED AERATION ON CHUTES,
For primary bibliographic entry see Field 8B.
W88-01907

TURBULENCE INTENSITY IN TRANSITION SECTIONS OF POOLS IN TRAPEZOIDAL CANALS,
For primary bibliographic entry see Field 8B.
W88-01908

PREDICTION OF WIND WAVE CHARACTERISTICS IN LARGE CANALS,
For primary bibliographic entry see Field 8B.
W88-01910

STOCHASTIC MODEL FOR THE LONG-TERM TRANSPORT OF STORED SEDIMENT IN A RIVER CHANNEL,
Western Washington Univ., Bellingham. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W88-01913

USE OF CURRENT METERS FOR CONTINUOUS MEASUREMENT OF FLOWS IN LARGE RIVERS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.

J. A. Derecki, and F. H. Quinn.
Water Resources Research WRERAQ, Vol. 23, No. 9, p 1751-1756, September 1987. 12 fig, 5 ref.

Descriptors: *River flow, *Current meters, *Continuous flow measurement, *Flow measurement, *St. Clair River, *Detroit River, *Measuring instruments, *Current meters, *Ice cover, Ice, Ice jams, Great Lakes, Continuous flow, Electromagnetic current meters, Acoustic Doppler current profiler, Simulation, Velocity distribution, Water currents.

Flows in the unregulated Great Lakes connecting channels, the St. Clair and Detroit Rivers, are normally determined using mathematical flow models with calibration based on periodic discharge measurements taken during the open-water seasons. Consequently, the calculated flows normally exhibit good accuracy during ice-free period, but may contain large errors during winter months with extensive ice cover. The St. Clair River is particularly prone to large ice jams because of practically unlimited ice flow supply provided by Lake Huron and an extensive river delta that retards the passage of these ice flows. The experimental results of continuous flow measurements using electromagnetic (EM) current meters and an acoustic Doppler current profiler (ADCP) meter are described for the 1983-1985 period. A record ice jam in the St. Clair River occurred in April 1984 and provided an excellent opportunity for testing the current meter program. Verification of current meter results was provided by flows transferred from the Detroit River, which was ice-free and permitted accurate flow simulation. The current meter flow measurement program illustrated high consistency of exponential (logarithmic) vertical distribution of velocities. Results indicate that accurate estimates of mean river flows can be obtained with a single well-placed current meter. However, the EM current meters are direct contact single-point sensors that are affected by frazil ice during winter of the year. The ADCP meter is a remote sensor of velocities in the overhead water column and is not affected by the frazil ice and weed problems. (Author's abstract)
W88-01914

MATHEMATICAL MODEL FOR UNSTEADY SUPERCRITICAL FLOW ON A MOBILE SANDY BED,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ingenieria.
J. Aparicio, and M. Berezowsky.
Hydrological Sciences Journal HSJODN, Vol. 32, No. 3, 313-327, September 1987. 10 fig, 11 ref, append.

Descriptors: *Mathematical models, *Supercritical flow, *Sediment transport, *River beds, Flow profiles, River flow, Simulation analysis, Flow velocity, Mathematical studies, Model studies.

Supercritical flow with sediment transport is a common phenomenon in steep rivers. This kind of flow presents features not present in rivers flowing in subcritical conditions. The development of a mathematical model to simulate supercritical flow with sediment transport in sandy rivers is described. Due to the complexity of unsteady supercritical flow, it is necessary to make some assumptions to describe its physical behavior without unreasonable mathematical difficulties. The following are adopted: (1) the flow is mainly one-dimensional; (2) the height of roll and cross waves can be added to the computed depths for design purposes; (3) vertical accelerations are negligible; (4) resistance to flow effects due to bed and wall roughness can be computed with steady flow formulae; (5) the Froude number at every cross section remains always greater than unity; and (6) wash load has a negligible effect on bottom channel variations as compared to bed load. The model is based on a numerical scheme for the integral version of the full governing equations and takes into account bottom configurations. (Lantz-PTT)
W88-01963

ANNUAL LOW FLOWS GENERATED BY MIXED PROCESSES,
Florida Univ., Gainesville. Dept. of Geography.
P. R. Waylen, and M. K. Woo.
Hydrological Sciences Journal HSJODN, Vol. 32, No. 3, 371-383, September 1987. 9 fig, 1 tab, 10 ref.

Descriptors: *River flow, *Low flows, *Mathematical studies, *Annual runoff, Ontario, Hydrologic properties, Seasonal variation, Gumbel distribution.

In areas where the annual low flow series is generated by more than one distinct hydrological process, a compounded Gumbel distribution can provide a satisfactory fit to the empirical data. The annual low flows of rivers in Northern Ontario are the result of storage depletion following either long periods of below freezing temperatures at the end of winter or early spring (spring low flows), or high evaporation in late summer and early fall (fall low flows). Use of the compounded Gumbel distribution adequately represents the return periods of low flows for the rivers studied. Parameters estimated for the distribution show noticeable spatial trends both in terms of the seasonal mean and the standard deviation of the low flows. (Author's abstract)
W88-01967

SHORT-RANGE RUNOFF FORECASTING FOR THE RIVER RHINE AT RHEINFELDEN: EXPERIENCES AND PRESENT PROBLEMS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Geographisches Inst.
H. Lang, H. Jensen, and D. Grebner.
Hydrological Sciences Journal HSJODN, Vol. 32, No. 3, p 385-397, September 1987. 6 fig, 8 ref.

Descriptors: *Runoff, *Forecasting, *Rhine River, Mathematical studies, Rainfall-runoff relationships, Hydrologic models, Quantitative analysis, Flood forecasting, Snow melt, Hydrologic budget.

The discharge of the Rhine upstream of Basel has been subject to forecasting at the Swiss Federal Institute of Technology, Zurich, for more than 20 years. The present state of the operational handling of the real-time short-range forecasting is outlined, together with a description of the model structure and of the underlying networks. The problems of spatial and temporal variation of precipitation need particular consideration. The complexity of the river basin is reflected in the pure basin model. An important part of the model deals with purely hydrological problems, i.e. the transfer from rainfall or melt rates to runoff. But even if this is well done and under all possible conditions of the seasons, there are further problems to be dealt with in operational real-time forecasting. The model must, for instance, be compatible with and organized according to the observational networks and the real-time data collection systems; artificial storage and release control measures should also be taken into account. In the case discussed here, a successful forecast of a flood event for more than 6 to 12 h ahead requires, moreover, reliable forecasts of rainfall and melt rates with adequate resolution in space and time. Because of the short response times and in order to meet the requirements of a lead time of three days, quantitative forecasts of precipitation and temperature are employed, including their variation in time and their distribution within the river basin. (Lantz-PTT)
W88-01968

MICROBIAL POLLUTION OF THE BLUE AND WHITE NILES AT KHARTOUM,
Khartoum Univ. (Sudan). Faculty of Agriculture.
For primary bibliographic entry see Field 5A.
W88-02023

EVALUATION OF THE FLUID DYNAMIC PROPERTIES OF MUD FLOWS ON MOUNT ST HELENS,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 2J.
W88-02270

VERTICAL, HORIZONTAL, AND DIEL DISTRIBUTION OF INVERTEBRATE DRIFT IN THE LOWER MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2H.
W88-02278

TWO-EQUATION MODEL FOR CONTAMINANT DISPERSION IN NATURAL STREAMS,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
For primary bibliographic entry see Field 5B.
W88-02328

EFFECT OF HYDROLOGICAL FACTORS ON TRACE METAL CONTAMINATION IN THE RIVER TAWE, SOUTH WALES,
University Coll. of Swansea (Wales). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W88-02334

PCB POLLUTION BEHAVIOUR IN THE RIVER SEINE,
Paris-6 Univ. (France). Inst. d'Hydrologie et de Climatologie.
For primary bibliographic entry see Field 5B.
W88-02341

NEW STUDIES OF URBAN FLOOD FREQUENCY IN THE SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 4C.
W88-02352

SIMULATION OF FLOOD HYDROGRAPHS FOR GEORGIA STREAMS,
Geological Survey, Doraville, GA. Water Resources Div.
E. J. Inman, and J. T. Armbruster.
Transportation Research Record TRREDM, No. 1073, p 15-23, 1986. 6 fig, 4 tab, 9 ref.

Descriptors: *Flood hydrographs, *Discharge hydrographs, *Georgia, *Design flow, *Design floods, *Flow rates, *Streams, Simulation, Equations, Regression analysis, Drainage systems, Model studies.

Flood hydrographs are needed for the design of many highway drainage structures and embankments. A method for simulating these flood hydrographs at urban and rural ungauged sites in Georgia is presented. The O'Donnell method was used to compute unit hydrographs from 355 flood events from 80 station. These average unit hydrographs were transformed to unit hydrographs having durations of one-fourth, one-third, one-half, and three-fourths lag time and then reduced to dimensionless terms by dividing the time by lag time and the discharge by peak discharge. Hydrographs were simulated for these 355 flood events and their widths were compared with the widths of the observed hydrographs at 50 and 75 percent of peak flow. The dimensionless hydrograph based on one-half lag-time duration provided the best fit of the observed data. Multiple-regression analysis was used to define relations between lag time and certain physical basin characteristics, of which drainage area and slope were significant for the rural equations, with impervious area being added for the Atlanta urban equation. A hydrograph can be simulated from the dimensionless hydrograph, peak discharge of a specific recurrence interval, and lag time obtained from regression equations for any site of less than 500/sq mi, the U. S. Geological Survey computer model CONROUT can be used. CONROUT produces a simulated outflow discharge hydrograph with a peak discharge of a specific recurrence interval. The diffusion analogy routing method with single linearization was used in this study. (Author's abstract)
W88-02353

EFFECT OF MAIN-CHANNEL ORIENTATION ON FLOOD PEAKS FOR STREAMS IN OHIO,
Ohio Dept. of Transportation, Columbus.
J. O. Hurd.
Transportation Research Record TRREDM, No. 1073, p 24-27, 1986. 4 fig, 22 ref.

Descriptors: *Floods, *Flood peak, *Streams, *Channels, *Drainage basins, *Ohio, *Rainfall-runoff relationships, *Geomorphology, Storm runoff, Runoff, Equations, Regression analysis.

Flood data from 205 unregulated rural drainage basins ranging in size from 0.012 to 5,993/sq mi were analyzed to determine whether main-channel orientation had any effect on flood peaks. No significant effect on flood peaks was found for unregulated rural streams in Ohio except for steep basins (main-channel slope > approximately 1 percent) that flow in nearly the same direction as the prevailing storm movement (<20-degree deviation). These basins in general produce higher flood peaks than those predicted by the U.S. Geological Survey regional regression equations for Ohio. (Author's abstract)
W88-02354

EVALUATION OF ALTERNATIVE HYDROGRAPH METHODS FOR HYDRAULIC DESIGN,
GKY and Associates, Inc., Springfield, VA.
For primary bibliographic entry see Field 7C.
W88-02355

CHARACTERIZATION AND DETERMINATION OF LIPOPHILIC HYDROCARBONS IN THE CHAO PHRAYA, BANG PAKONG AND THA-CHIN RIVERS AND THE UPPER GULF OF THAILAND,
Tokyo Univ. of Science (Japan). Faculty of Pharmaceutical Sciences.
For primary bibliographic entry see Field 5B.
W88-02362

HYDROLOGIC SIMULATION OF THE BRANDYWINE BASIN,
National Chunghsing Univ., Taichung (Taiwan). Graduate Inst. of Urban Planning.
S.-L. Huang, and J. D. Keenan.
Water Resources Bulletin WARBAQ, Vol. 23, No. 3, p 403-421, June 1987. 10 fig, 3 tab, 23 ref.

Descriptors: *Model studies, *Hydrology, *Simulation, *Brandywine Basin, Watersheds, Spatial variation, Rainfall, Land use, Planning, Policy making.

A deterministic hydrologic model, encompassing the hydrologic regime and all water uses, is developed by integrating empirical hydrologic relationships. The Brandywine Basin, located in southeastern Pennsylvania and northern Delaware, is used as an example to demonstrate this modeling effort. The basin is divided into 19 subwatersheds to account for the spatial variation of resource characteristics. The output of the model is the response of the hydrologic system to various inputs such as precipitation, land use characteristics and policy decisions. This modeling effort is applicable to watersheds similar to the Brandywine Basin in size, and once the model is developed and validated, can be applied continuously in the management and planning of water resources such as predicting the hydrologic effects of proposed projects and simulating hydrologic information. (Author's abstract)
W88-02380

GENERALIZED WATERSHED LOADING FUNCTIONS FOR STREAM FLOW NUTRIENTS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W88-02386

DESIGN OF DUAL-PURPOSE DETENTION SYSTEMS USING DYNAMIC PROGRAMMING,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W88-02413

DIMENSIONLESS SOLUTION OF LAG TIME FOR DIVERGING SURFACE,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-02442

2F. Groundwater

DISCUSSION OF GROUNDWATER MONITORING,
Environmental Data, Inc., Grand Rapids, MI.
For primary bibliographic entry see Field 7A.
W88-01518

LAND DISPOSAL EFFECTS ON GROUNDWATER,
Michigan Dept. of Public Health, Lansing. Bureau of Environmental Occupational Health.
For primary bibliographic entry see Field 5C.
W88-01519

MINE WATER.
International Mine Water Association.
For primary bibliographic entry see Field 4B.
W88-01554

EFFECT OF GROUNDWATER RE-ESTABLISHMENT ON THE SETTLEMENT OF OPENCAST MINE BACKFILLS IN THE UNITED KINGDOM,
Nottingham Univ. (England). Dept. of Mining Engineering.
For primary bibliographic entry see Field 4B.
W88-01571

ASSESSING IMPACT OF SURFACE MINING ON RECHARGE,
New Mexico Bureau of Mines and Mineral Resources, Socorro.
For primary bibliographic entry see Field 4C.
W88-01573

REBUILDING OF ORIGINAL WATER BALANCE IN KARSTIC RESERVOIRS,
Central Inst. for Mining Development, Budapest (Hungary).
For primary bibliographic entry see Field 4B.
W88-01574

GEOPHYSICAL PROSPECTING FOR MINED AREAS IDENTIFICATION. 'SAN JOSE' MINE CASE HISTORY (CACERES - SPAIN),
Compania General de Sondeos S.A., Madrid (Spain).
For primary bibliographic entry see Field 4B.
W88-01582

PROBLEMS OF MUD SOLID INTRUSIONS INTO MINING PITS,
Institute of Geology and Exploration, Xian (China).
For primary bibliographic entry see Field 8D.
W88-01584

HOT WATER SEEPAGE INTO SHALLOW COAL MINES OF MANUGURU COALBELT, GODAVARI VALLEY COALFIELD ANDHRA PRADESH, INDIA,
Singareni Collieries Co. Ltd., Kothagudem (India).
M. K. Krishna, G. Mattaiah, and A. Venkatappaiah.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 979-989, 4 fig, 2 tab, 7 ref.

Descriptors: *Seepage, *Thermal water, *Coal mines, *Groundwater movement, *Groundwater management, *Geohydrology, *Mine drainage, *India, Igneous rocks, Water temperature, Aquifers.

Occurrence of hot water in shallow coal mines of Permian age in the Manuguru coalbelt, without apparent igneous activity, occurs in India. A number of hot and cold springs are located in and around this coalbelt in fault zones. This anomalous thermal gradient is possibly due to the spatial redistribution of heat by convection in groundwater flowing through high permeability conduits in the basement rocks extending into the overlying lower Gondwana sediments. It is estimated that the thermal reservoir temperature is around 150C. It is likely that the thermal waters emerge onto the surface after the circulation of meteoric water, mainly through Archaean gneisses which are the basement rocks, up to depths of about 5 km. The waters both in the shallow and deep aquifer systems have a high fluoride and silica content. Detailed geophysical surveys and geohydrological testing in specially designed structures are expected to help in a better understanding of the geometry and structural configuration of the hot water aquifer system and in planning the dewatering operations. Hot water pumped out in this process may be utilized for thermal power generation and irrigation. (See also W88-01554) (Lantz-PTT)
W88-01585

HYDROGEOLOGICAL INVESTIGATIONS IN MINING (WITH REFERENCE TO USSR EXPERIENCE),
Leningrad Mining Inst. (USSR).
For primary bibliographic entry see Field 4B.
W88-01586

ISSUES OF AQUIFER LEAKAGE IN IN-SITU URANIUM MINING,
Canonie Engineers, Inc., Denver, CO.
R. S. Popielak, and J. Siegel.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 1003-1014, 6 fig.

Descriptors: *Aquifers, *Mine drainage, *Groundwater movement, *Uranium mines, Geohydrology, Permeability, Leakage, Aquifers, Simulation analysis.

Regulatory agencies require operators of uranium in-situ solution mines to demonstrate that there is adequate hydraulic confinement of the ore zone aquifer by upper and lower strata of low permeability. The purpose of the regulation is to prevent the migration of potentially hazardous solutions out of the ore zone aquifer or to assure its subsequent return should it penetrate the confinement. In most cases, the ore zone is not totally confined. There is some leakage or hydraulic communication between the ore zone aquifer and its confining beds. The potential for leakage does not necessarily mean that mining is environmentally hazardous. Generally, leakage tends to lower the intensity of the pressure field between injection wells and the production well, causing solution travel distances and times to be greater. However, natural features of the production aquifer usually alleviate this situation. These features include the limited vertical extent of the ore zone within the production aquifer and stratification of the production aquifer. The impact of leakage can further be reduced by the design of the operational features such as well spacing, pumping and injection rates, and partial screening of wells. The simulated effect of leakage on a hypothetical in-situ leach operation with three different magnitudes of confinement leakage is demonstrated. A fourth case examines the effects of stratification of the ore zone aquifer upon the flow pattern and leachate travel times. (See also W88-01554) (Author's abstract)
W88-01587

INFLUENCE OF MINING ON THE GROUNDWATER MINERALIZATION IN THE UPPER SILESIAN COAL BASIN,
Instytut Geologiczny, Sosnowiec (Poland). Upper Silesian Branch.
For primary bibliographic entry see Field 4C.
W88-01588

STUDY OF FORMATION OF FISSURE-KARST WATER INFLOWS INTO MINE WORKINGS,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
N. V. Sokulina.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 1039-1044, 3 ref.

Descriptors: *Karst hydrology, *Mine drainage, *Groundwater movement, *Groundwater management, Geohydrology, Simulation analysis, Flow profiles.

In exploring a deposit being flooded by fissure-karst water inflows from a river valley, geohydrology studied to providing effective and safe mine works and to predict changes in geohydrological conditions. Geomorphological and geohydrological data, along with results of prospecting drilling indicated that the valley of an old river, is associated with the most permeable carbonate rocks. Based on the properties of carbonate rocks both in the river valley and deposit, a mathematical model was constructed for estimating the predicted water inflows and studying possible changes in geohydrological conditions with the dewatering of the deposit. The simulation data demonstrated that during dewatering shallow quarries located at the distance of 4-5 km from the river the predicted water inflow values amount to a few thousand cu m/day. The dewatering of deep quarries, located at a distance of 1.5-2 km from the river, would be followed by intensive water inflows into mine workings which exceed water inflows into shallow quarries. Development is expected to cause activation of karst-forming processes, quantitative prediction of which is presently impossible. (See also W88-01554) (Lantz-PTT)
W88-01590

CASE STUDY: HYDROGEOCHEMICAL PROSPECTION IN A LEAD-ZINC MINE (VEDRIN, BELGIUM),
Liege Univ. (Belgium). Lab. de Geologie Appliquee.
M. Uyttendaele.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 1045-1056, 2 fig, 10 tab, 4 ref.

Descriptors: *Geohydrology, *Geochemistry, *Lead, *Zinc, *Mines, *Case studies, Geological studies, Iron, Groundwater movement, Springs.

The Vedrin deposit in Nemur, Belgium was exploited until 1945 for Fe, Pb, and Zn. The ore body was localized in carbonate rocks. Since then the mine has been converted to supplying potable water. Many scientific reports indicated that there may still be unknown ore bodies. A sampling program was conducted using two parameters: space, 15 springs are taken into account; and time, the springs were analyzed once a week for 16 wk. HCO3, SO4, Cl, Mg, Na, and K were analyzed by classical analytical methods, whereas Fe, Zn, Mn, Br, Sr were quantified with the PIXE (particle induced X-ray emission) method. Different mathematical techniques were applied: correlation between elements, correlation between springs, cluster analysis, principal component analysis. In spite of the short distance between sampling points, the springs present distinct individual characteristics. The variation in time of these characteristics do not affect the statistical arrangement of the springs and thus do not mask their profile. Second, the most discriminant factor between the springs is a factor of mineralization which permits its use as a prospecting guide. (See also W88-01554) (Author's abstract)
W88-01591

GROUND FRACTURES DUE TO LONGWALL MINING SUBSIDENCE,
Nottingham Univ. (England). Dept. of Mining Engineering.
For primary bibliographic entry see Field 8E.
W88-01592

WATER IN MINING AND UNDERGROUND WORKS (EL AGUA EN LA MINERIA Y TRABAJOS SUBTERRANEOS).
Asociacion Nacional de Ingenieros de Minas, Granada (Spain).
For primary bibliographic entry see Field 4B.
W88-01601

FIELD FACILITIES FOR SUBSURFACE TRANSPORT RESEARCH,
Oak Ridge National Lab., TN. Environmental Sciences Div.
R. J. Luxmoore, and C. H. Abner.
Environmental Sciences Division Publication No. 2843, April 1987. 32 p, 18 fig, 3 tab. DOE Contract No. DE-AC05-840R21400.

Descriptors: *Groundwater movement, *Soil properties, *Soil water, Path of pollutants, *Infiltration, *Soil water movement, Macroporosity, Soil porosity, Geohydrology, Flow patterns, Simulation analysis, Groundwater, Computer models.

Field installations for research on the roles of macropores and the spatial variability of soil physical and chemical characteristics in subsurface transport of water and solutes are described. Facilities for transport studies dominated by one-, two-, and three-dimensional flow processes provide a comprehensive approach to quantifying the contributions of precipitation (new) and antecedent (old) water to subsurface transport for a range of hydrologic conditions. A computer data acquisition system for intensively monitoring subsurface flow rates, perched water table dynamics, and soil water potentials also has the capability for data analysis during precipitation events. Two small watershed areas (approximately 0.5 ha) with deciduous forest vegetation but with contrasting soil profile development (3 m vs 25 m depth to bedrock) have been similarly instrumented with these installations for comparative studies. Scientists interested in subsurface transport processes are invited to develop cooperative projects using these watershed facilities. Experimental and simulation modeling methods may be used to test hypotheses or evaluate concepts. (Author's abstract)
W88-01605

DOE DEEP PROBE - FIELD EVALUATION AND PLANNING WORKSHOP,
Department of Energy, Washington, DC. Office of Health and Environmental Research.
For primary bibliographic entry see Field 5B.
W88-01607

GROUND WATER QUALITY PROTECTION,
Oklahoma Univ., Norman. Environmental and Ground Water Inst.
For primary bibliographic entry see Field 5G.
W88-01655

EFFECTS OF A BIOMODAL PORE DISTRIBUTION ON MATRIX DIFFUSION IN A FRACTURED POROUS MEDIUM,
Sandia National Labs., Albuquerque, NM. Earth Sciences Div.
For primary bibliographic entry see Field 5B.
W88-01658

TRANSPORT OF CONTAMINANTS IN THE SUBSURFACE: THE ROLE OF ORGANIC AND INORGANIC COLLOIDAL PARTICLES.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W88-01674

REGIONAL UNDERPRESSURING IN DEEP BRINE AQUIFERS, PALO DURO BASIN, TEXAS: 1. EFFECTS OF HYDROSTRATIGRAPHY AND TOPOGRAPHY,
Texas Univ. at Austin. Bureau of Economic Geology.
R. K. Senger, and G. E. Fogg.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1481-1493, August 1987. 11 fig, 42 ref.

Descriptors: *Aquifers, *Aquifer characteristics, *Underpressuring, *Groundwater movement, *Saline water, Groundwater, Palo Duro Basin, Texas, Ogallala Aquifer, Hydrostratigraphy, Topography, Mathematical equations, Model studies, Simulation analysis, Subsurface drainage, Brines, Groundwater recharge.

Deep brine aquifers of the Palo Duro Basin, Texas Panhandle, ranging in depth from about 1000 to 3000 m below land surface, are underpressured compared with the shallow Ogallala aquifer. Two-dimensional simulations of flow in an east-west regional cross-sectional model through the basin reveal the causes of underpressuring as well as mechanisms of groundwater circulation in the basin. The regional groundwater flow regime consists of a shallow flow system governed primarily by topography and a deeper flow system recharging in the New Mexico area and passing deep beneath the Pecos River into the deep brine aquifers of the Palo Duro Basin. The low-permeability Evaporite aquitard limits flow between the shallow and deep systems, although leakage through the aquitard is important on a regional scale and could contribute a significant portion of water to the deep aquifers. Repeated simulations with the model demonstrate that chief causes of underpressuring are regional topography and geology. The elevated position of the Ogallala aquifer on the High Plains together with its segregation from the deep brine aquifers by the low-permeability Evaporite aquitard creates an apparent underpressuring that is further accentuated by efficient drainage through the permeable granite wash deposits in the Deep-Basin Brine aquifer. The Pecos River serves as a discharge area of some of the groundwater from the west that would otherwise move downdip into the deep aquifers; thus capture of recharge water enhances underpressuring in the deep section beneath the western half of the High Plains. (See also W88-01682) (Author's abstract)
W88-01681

REGIONAL UNDERPRESSURING IN DEEP BRINE AQUIFERS, PALO DURO BASIN, TEXAS: 2. THE EFFECT OF CENOZOIC BASIN DEVELOPMENT,
Texas Univ. at Austin. Bureau of Economic Geology.
R. K. Senger, C. W. Kreitler, and G. E. Fogg.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1494-1504, August 1987. 10 fig, 1 tab, 32 ref.

Descriptors: *Aquifers, *Aquifer characteristics, *Underpressuring, *Groundwater movement, *Saline water, Groundwater, Palo Duro Basin, Texas, Mathematical equations, Model studies, Simulation analysis, Sedimentary basins, Geologic erosion, Geologic processes, Aquitards, Escarpments, Brines.

The evolution of sedimentary basins, involving uplift, deposition, and erosion causes major changes in basin hydrodynamics and the hydrochemistry of basinal fluids. The role of these geologic processes is examined in the Palo Duro Basin of Texas with the help of a cross-sectional groundwater flow model employing time-dependent boundary conditions and a source term representing erosional unloading. Transient simulations of groundwater flow show that uplift and tilting of the basin (10-15 m.y. ago) caused a significant increase in groundwater flow rates. Timing of the erosional events implies that significant underpressuring (head difference between shallow and deep aquifers in excess of 175 m), and changes in the groundwater flow pattern, occurred within the last 1-2 m.y. as a result of the erosional retreat of the Eastern Caprock Escarpment. Modeling also indicates that erosional unloading associated with the

retreat of the Caprock Escarpment was ineffective in creating large-scale underpressuring in the Deep-Basin Brine aquifer. Only in the vicinity of the escarpment could erosional unloading and the resulting expansion of the underlying aquitard create subhydrostatic conditions within the aquitard. (See also W88-01681) (Author's abstract)
W88-01682

LABORATORY AND SIMULATION STUDIES OF SOLUTE TRANSPORT IN FRACTURE NETWORKS,
Idaho National Engineering Lab., Idaho Falls.
For primary bibliographic entry see Field 5B.
W88-01683

GEOCHEMICAL EVOLUTION OF GROUNDWATER IN STRATIFIED-DRIFT AND ARKOSIC BEDROCK AQUIFERS IN NORTH CENTRAL CONNECTICUT,
Geological Survey, Albany, NY. Water Resources Div.
R. J. Rogers.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1531-1545, August 1987. 7 fig, 5 tab, 31 ref.

Descriptors: *Groundwater, *Geochemistry, *Aquifers, *Bedrock aquifers, Bedrock, Chemical composition, Groundwater chemistry, Carbon dioxide, Calcite, Chemical analysis, Model studies, Connecticut, Kaolinite.

Groundwaters in both stratified-drift and arkosic bedrock aquifers are dilute (dissolved solid concentration less that 300 milligrams/liter), of similar chemical composition, and evolve along similar paths. Calcite, potassium feldspar, sodic plagioclase, accessory silicates, and probably pyrite and barite are reactants in both aquifer types. Water in the stratified-drift aquifers is in chemical equilibrium with kaolinite and generally has reached equilibrium with chalcedony, which controls H2SiO4 concentrations. In the bedrock aquifers, kaolinite forms as a product in the less evolved water, and calcium montmorillonite and calcite form as products in the more highly evolved water. CO2 is a major reactant in both types of aquifers, which are probably open with respect to CO2. The absolute dissolution rates of reactant minerals have a greater effect on groundwater chemistry than do their relative abundance. Calcite, a minor constituent, contributes to water chemistry significantly more than silicates in both types of aquifers. The greater degree of geochemical evolution of water in the bedrock aquifers compared to that of water in the stratified-drift aquifers is attributed to its longer residence time in the bedrock. (Author's abstract)
W88-01686

ANTHROPOGENIC ANOXIFICATION ('EUTROPHICATION') OF THE WATER TABLE REGION OF A DEEP PHREATIC AQUIFER,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 5B.
W88-01688

SIMULTANEOUS INVERSION OF HYDROGEOLOGIC DATA AND THERMAL DATA: 1. THEORY AND APPLICATION USING HYDRAULIC HEAD DATA,
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
A. D. Woodbury, L. Smith, and W. S. Dunbar.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1586-1606, August 1987. 15 fig, 8 tab, 48 ref, 2 append. National Sciences and Engineering Research Council of Canada Grant A 8492.

Descriptors: *Groundwater movement, *Geohydrology, *Model studies, *Simulation analysis, *Data interpretation, Mathematical models, Hydraulic head, Algorithms, Mathematical equations, Mathematical studies, British Columbia, Canada, Permeability coefficient, Hydraulic models, Groundwater movement.

One goal in solving the inverse problem in groundwater hydrology is to obtain parameter estimates for use in a simulation model. A philosophy about the inverse was adopted that takes the form of constructing a variety of models under different norms. Large differences in parameter estimates obtained using different norms suggests the possibility of an incorrect interpretational model. An optimization procedure is used that is based on the constrained simplex method. This algorithm easily handles constraints, does not require derivatives of the functional with respect to the parameters, and can be employed to minimize complicated functionals. The algorithm produces a cluster of search points in parameter space about the global minimum of the objective function. Each of these points generated data that matches observed values within a prescribed tolerance. The centroid of the search points is taken as the best estimate of parameters. This inverse technique was applied to a sparse, inaccurate hydraulic-head data set observed at Downie Slide, British Columbia, Canada. For this cross-sectional problem interpolation of hydraulic head values using kriging techniques was not possible. The domain is represented as a homogeneous, isotropic medium. Four parameters are estimated: the free surface position of the water table and three boundary conditions. Further simulations using a synthetic data set with assumed properties similar to that of Downie Slide show that with noise-free data and an adequate spacing between measurement points, it is possible to interpolate an unbiased estimate of hydraulic head data at all nodes in the equivalent discretized domain. When the inverse technique is applied, the hydraulic conductivity structure is correctly identified. The implications for Downie Slide are that in order to resolve more than a simple hydraulic conductivity structure, accurate field measurements of hydraulic head, a better spacing between measurements and more detailed knowledge of the boundary conditions are required. (Author's abstract)
W88-01691

APPROXIMATE SEMIANALYTICAL SOLUTION FOR TRACER INJECTION TESTS IN A CONFINED AQUIFER WITH A RADIALLY CONVERGING FLOW FIELD AND FINITE VOLUME OF TRACER AND CHASE FLUID,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W88-01692

BACTERIA IN DEEP COASTAL PLAIN SEDIMENTS OF MARYLAND: A POSSIBLE SOURCE OF CO2 TO GROUNDWATER,
Geological Survey, Columbia, SC. Water Resources Div.
F. H. Chapelle, J. L. Zelibor, D. J. Grimes, and L. L. Knobel.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1625-1632, August 1987. 5 fig, 2 tab, 23 ref.

Descriptors: *Groundwater, *Carbon dioxide, *Bacteria, *Coastal aquifers, Maryland, Sediments, Bacterial analysis, Methane bacteria, Metabolism, Organic matter, Aquifers, Microbiological studies, Sulfur bacteria.

Nineteen cores of unconsolidated Coastal Plain sediments from depths of 14 to 182 m below land surface near Waldorf, Maryland, were collected and examined for metabolically active bacteria. The age of the sediments cored range from Miocene to Early Cretaceous. Acridine orange direct counts of total (viable and nonviable) bacteria in core subsamples ranged from 10 to the 8th power to 10,000 bacteria/gram of dry sediment. Direct counts of viable bacteria ranged from 1,000,000 to 1,000 bacteria/gram of dry sediment. Three cores contained viable methanogenic bacteria, and seven cores contained viable sulfate-reducing bacteria. The observed presence of bacteria in these sediments suggest that heterotrophic bacterial metabolism, with lignitic organic material as the primary substrate, is a plausible source of CO2 to groundwater. However, the possibility that abiotic processes also produce CO2 cannot be ruled out. Estimated rates of CO2 production in the noncalcareous Magothy/Upper Patapsco and Lower Patapsco aquifers based on mass balance of dissolved inorganic carbon, groundwater flow rates, and flow path segment lengths are in the range of 0.001 to 0.00001 mmol/liter/year. Isotope balance calculations suggest that aquifer-generated CO2 is much heavier isotopically (approximately -10 to +5 per mil) than lignite (approximately -24 per mil) present in these sediments. This may reflect isotopic fractionation during methanogenesis and possibly other bacterially mediated processes. (Author's abstract)
W88-01694

LABORATORY EVIDENCE OF THE SCALE EFFECT IN DISPERSION OF SOLUTES IN POROUS MEDIA,
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-01698

GROUNDWATER FLOW TO A WELL IN A LAYERED POROUS MEDIUM: 1. STEADY FLOW,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
C. Maas.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1675-1681, August 1987. 3 fig, 19 ref, 2 append.

Descriptors: *Groundwater movement, *Screened wells, *Porous media, Geohydrology, Mathematical studies, Mathematical equations, Steady flow, Wells, Well hydraulics, Groundwater, Vertical flow, Horizontal flow.

Analytical solutions of steady multiple-aquifer problems usually assume the flow of groundwater to be essentially horizontal in aquifers and vertical in aquitards. These assumptions yield formulae that are economical to evaluate. The simplifications, however, need the theoretical check provided by the derived analytical formula. The formula considers steady flow of groundwater to a partially screened well in a layered porous medium. Both the horizontal and vertical flow components are taken into account. (See also W88-01700) (Author's abstract)
W88-01699

GROUNDWATER FLOW TO A WELL IN A LAYERED POROUS MEDIUM: 2. NONSTEADY MULTIPLE-AQUIFER FLOW,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
C. Maas.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1683-1688, August 1987. 3 fig, 1 tab, 7 ref, 2 append.

Descriptors: *Groundwater movement, *Screened wells, *Porous media, Geohydrology, Mathematical study, Mathematical equations, Unsteady flow, Wells, Well hydraulics, Groundwater, Aquifers, Aquitards, Elastic storage, Horizontal flow, Vertical flow.

The generalized integral transform method employed in part 1 of this series is extended to solve the problem of nonsteady flow to a well in a layered porous medium. Distinction is made between aquifers, with mainly horizontal flow, and aquitards, with vertical flow. Elastic storage is taken into account in both aquifers and aquitards. The number of layers is arbitrary. The formula obtained serves as a theoretical check on an approximate solution to the same problem that was obtained earlier. (See also W88-01699) (Author's abstract)
W88-01700

COMPARISON OF EARTH RESISTIVITY AND ELECTROMAGNETIC SURVEY METHODS,
Blasland and Bouck Engineering, Syracuse, NY.
For primary bibliographic entry see Field 7B.
W88-01713

MODELING GROUNDWATER FLOW BY MEANS OF A HYBRID TRAJECTORY IMAGE, BOUNDARY INTEGRAL EQUATION METHOD,
Purdue Univ., Lafayette, IN. Dept. of Earth and Atmospheric Sciences.
J. S. Jean, and D. I. Leap.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 217154/AS. Price codes: A11 in paper copy, A01 in microfiche. Water Resources Research Center, W. Lafayette, IN, Technical Report No. 182, June 1987. 228 p, 5 tab, 57 fig, 30 ref, 6 append. Contract No. 140-08-0001-G1224. Project No. USGS G1224-05.

Descriptors: *Hydrologic modeling, *Groundwater movement, *Trajectory Image Method, *Boundary conditions, Analytical techniques, Model studies, Path of pollutants, Image theory, Boundary integral equation method, Hybrid trajectory image, Computer programs.

The trajectory image method (TIM), a new modeling technique based on image theory, can be used to find head, gradients, velocities, and flow directions. TIM derives from the idea that particles emitted by sources or adsorbed by sinks may be reflected by impermeable boundaries, or they may be partially absorbed, reflected, and partially transmitted by boundaries of differing hydraulic conductivities but with abrupt changes in their hydraulic heads. Particles move until their changes in head become negligible. Each reflection represents an image in terms of the boundaries where the trajectories are reflected, thus a great number of imaginary points, depending on accuracy desired after projection, are generated. The traveling distances of particles are measured from sources or sinks to the current ray-boundary intersections. Then the total head and gradients at each observation point are found by superposing heads and gradients of particle trajectories that pass through or close to the observation point. The number of reflections for each trajectory depends on the geometry of the boundary. Although TIM requires considerably more computing time with standard mainframes, run times were reduced by an order of magnitude with a supercomputer. Also, a combination of TIM and BIEM (boundary integral equation method)-TIMBIE-can reduce time requirements because of elimination of interpolation of internal accounting points. The hybrid TIMBIE computes boundary values of head and normal gradients of x and y components at internal accounting points by BIEM. TIMBIE can be used to test the results of TIM. This is because the internal values in BIEM are derived from boundary conditions defined by TIM. If heads and normal gradients on boundary conditions are accurate, the internal values by TIM and TIMBIE should agree. This testing procedure is rather reliable and convenient in comparing the values at all interior points, because both methods are completely independent of each other at accounting points (nodes). (USGS)
W88-01762

FROM HOES TO HERBICIDES: AGRICULTURE AND GROUNDWATER QUALITY,
Iowa State Geological Survey, Iowa City.
For primary bibliographic entry see Field 5B.
W88-01882

COMPARISON OF GEOSTATISTICAL METHODS FOR ESTIMATING TRANSMISSIVITY USING DATA ON TRANSMISSIVITY AND SPECIFIC CAPACITY,
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
S. Ahmed, and G. De Marsily.
Water Resources Research WRERAQ, Vol. 23, No. 9, p 1717-1737, September 1987. 12 fig, 7 tab, 34 ref.

Descriptors: *Model studies, *Statistical methods, *Transmissivity, *Aquifers, Groundwater, Specific capacity, Mathematical equations, Mathematical studies, Estimating, Kriging, Regression analysis, Linear regression, Cokriging.

For regional aquifer modeling it is often necessary to produce maps of the distribution of the transmissivity in the aquifer, for example, as initial input for the calibration phase of the model, either by automatic or by trial and error procedures. Such estimations must be based on all possible information available in the field; in many instances, direct transmissivity measurements from pumping tests are scarce, whereas indirect estimates based on specific capacity data are more numerous. It is, however, possible to use jointly both types of data when a geostatistical estimation technique is used. Four such methods were compared: (1) kriging combined with linear regression, (2) cokriging, (3) kriging with an external drift, and (4) kriging with a guess field. The comparison was made both on a set of real field data and on a theoretical case, where the 'true' solution is known. Cokriging is the more rigorous method and requires less assumptions. Kriging combined with linear regression can be used only in the case of two variables: if the residuals of the regression of one variable on the other are spatially uncorrelated, or if the correlation coefficient between them is high. Kriging with an external drift can be used for an unlimited number of variables, like cokriging. Kriging with an guess field has not shown, at least in this case, any particular feature or advantage that could make its use of interest in any particular situation. (Wood-PTT)
W88-01912

CRITICAL CHEMICAL REACTION RATES FOR MULTICOMPONENT GROUNDWATER CONTAMINATION MODELS,
Toledo Univ., OH. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-01918

SYSTEM MODELLING OF THE INTERACTION BETWEEN SURFACE AND GROUND WATERS IN PROBLEMS OF HYDROLOGY,
Institut Gidrodinamiki, Novosibirsk (USSR).
For primary bibliographic entry see Field 2A.
W88-01962

APPLICATION OF INFILTRATION EQUATIONS TO A CATCHMENT WITH LARGE SPATIAL VARIABILITY IN INFILTRATION,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 2A.
W88-01969

GROUNDWATER FLOW IN A BOG-FEN COMPLEX, LOST RIVER PEATLAND, NORTHERN MINNESOTA,
Syracuse Univ., NY. Dept. of Geology.
D. I. Siegel, and P. H. Glaser.
Journal of Ecology JECOAB, Vol. 75, No. 3, p 743-754, September 1987. 7 fig, 22 ref.

Descriptors: *Groundwater movement, *Peat bogs, *Wetlands, *Fens, *Minnesota, *Surface-groundwater relations, Geohydrology, Water level, Seasonal variation, Alkalinity, Hydrogen ion concentration, Acidity, Aquatic plants.

The geohydrology of a spring-fen mound, water track, and raised bog in the remote Lost River peatland, northern Minnesota, was investigated by measurements of the groundwater levels and chemistry of groundwater in observation wells. Water level measurements indicate that all the major physiographic features in the mire - a raised bog, spring fen, and intervening water track - are zones of groundwater discharge during parts of the year. Sodium concentrations in peat pore water change linearly with depth, indicating the upward advection of solutes in groundwater. Alkalinity and pH profiles indicate that acidic bog waters are neutralized below 0.5 m in the peat profile. A small change in the volume of groundwater discharge in the peatland may therefore be sufficient to neutralize the acidic waters on the bog surface and greatly affect the vegetation. (Author's abstract)
W88-01982

NITROGEN AND WATER BALANCE STUDIES IN RELATION TO FARMYARD MANURE AND N-FERTILIZER APPLICATIONS TO SRI LANKAN LUVISOLS,
Sri Lanka Univ., Peradeniya. Postgraduate Inst. of Agriculture.
For primary bibliographic entry see Field 5B.
W88-02081

GROUNDWATER FLOW PATHS AND HYDROGEOCHEMISTRY IN DEEP GRANITES AND GNEISSES (GRUNDWASSERFLIESSWEGE UND HYDROGEOCHEMIE IN TIEFEN GRANITEN AND GNEISEN),
Abteilung Umweltschutz des Kantons Aargau, Aarau (Switzerland).
W. Kanz.
Geologische Rundschau, Vol. 76, No. 1, p 265-283, 1987. 11 fig, 4 tab, 30 ref.

Descriptors: *Water chemistry, *Geochemistry, *Granites, *Aquifers, *Mineralization, *Flow system, Crystalline rocks, Methane, Oxygen, Carbon dioxide, Groundwater movement, Geohydrology, Switzerland.

Since 1982, water samples from six boreholes, 1.3 to 2.5 km deep, from northern Switzerland as well as from a rock laboratory in the Central Swiss Alps (Aare granite) have yielded a host of new findings on deep crystalline ground water hydrology. Isotope and chemical analyses which included comparative samples from a regional investigation program show that the composition of crystalline ground waters depends mainly on their position in regional flow systems. In crystalline rocks, local flow systems differ chemically from deeper ones in that they lack almost any easily soluble components. Their low mineral content results mainly from precipitation and thus varies with different climatic environments. Deeper ground water flow systems show high mineralization (esp. Na(+) and Cl(-)). As their stable isotope contents indicate, they develop mainly through infiltration from the large crystalline massifs, like the southern Black Forest. Due to their high hydraulic potentials and lack of sedimentary aquitards they have a key function in the interaction between atmosphere and deep lithosphere. Some of our results suggest that one and the same aquifer may contain chemically different ground waters: permeable portions will hold the type which is prevalent in the region whereas less permeable areas contain special types of higher mineralization. (There is however no regular increase in salinity with depth). Nitrogen and sometimes CO2 and methane are the main dissolved gases in deep crystalline ground waters in all boreholes sampled. There is no tritium, little or no radiocarbon. (Author's abstract)
W88-02097

ANALYSIS OF PUMPING TESTS IN WELLS WITH CAPACITY EFFECT TAKING INTO CONSIDERATION THE ENTRANCE WELL LOSS (PRISE EN COMPTE DE LA PERTE DE CHARGE A L'ENTREE LORS DE L'ETUDE DES NAPPES D'EAU SOUTERRAINES PAR POMPAGE DANS DES PUITS A EFFET DE CAPACITE),
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
R. Plegat.
Comptes Rendus de l'Academie des Sciences (Series 2) CHDCAQ, Vol. 304, No. 11, p 591-596, March 1987. 5 fig, 6 ref.

Descriptors: *Pumping tests, *Data interpretation, Pump wells, Well hydraulics, Drawdown, Water table.

The capacity effect which is usually analyzed in the case of large diameter wells without entrance loss is here considered for wells drilled with high loss. (Author's abstract)
W88-02099

TRANSPORT OF ENERGY-RELATED ORGANIC COMPOUNDS AND MIXTURES IN SUBSURFACE ENVIRONMENTS,

Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-02263

SUBSURFACE FLOW AND TRANSPORT OF ORGANIC CHEMICALS: AN ASSESSMENT OF CURRENT MODELING CAPABILITY AND PRIORITY DIRECTIONS FOR FUTURE RESEARCH (1987-1995),
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W88-02264

PROCEEDINGS, SECOND INVESTIGATORS' MEETING -- SAVANNAH RIVER EXPLORATORY DEEP PROBE.
For primary bibliographic entry see Field 5B.
W88-02265

GROUNDWATER QUALITY PROTECTION POLICIES FOR THE ROCKY MOUNTAIN REGION AND THE NATION.
Colorado Water Resources Research Inst., Fort Collins.
For primary bibliographic entry see Field 5G.
W88-02269

GROUNDWATER TREATMENT TECHNOLOGY,
DETOX, Inc., Dayton, OH.
For primary bibliographic entry see Field 5G.
W88-02322

REGIONAL HYDROGEOLOGIC RESEARCH IN THE PALO DURO BASIN FOR NUCLEAR-WASTE REPOSITORY SITING,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 5E.
W88-02331

GEOTECHNICAL CONSIDERATIONS FOR THE DESIGN OF AN EXPLORATORY SHAFT FACILITY FOR A NUCLEAR WASTE REPOSITORY IN DEAF SMITH COUNTY, TEXAS,
Woodward-Clyde Consultants, Houston, TX.
For primary bibliographic entry see Field 5E.
W88-02332

EFFECT OF ASH DISPOSAL PONDS ON GROUNDWATER QUALITY AT A COAL-FIRED POWER PLANT,
Wisconsin Univ.-Madison. Water Resources Center.
For primary bibliographic entry see Field 5E.
W88-02340

OPTIMAL MANAGEMENT OF A REGIONAL AQUIFER IN EASTERN SAUDI ARABIA,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Earth Sciences.
For primary bibliographic entry see Field 4B.
W88-02381

GROUNDWATER TEMPERATURE FLUCTUATIONS AT LYONS FERRY FISH HATCHERY, WASHINGTON,
Battelle Pacific Northwest Labs., Richland, WA.
P. L. Oberlander, and D. A. Myers.
Water Resources Bulletin WARBAQ, Vol. 23, No. 3, p 487-492, June 1987. 5 fig, 3 ref. DOE Contract DE-AC0676RLO 1830.

Descriptors: *Model studies, *Groundwater, *Fish hatcheries, *Water temperature, *Aquifers, Numerical analysis, Simulation, Temperature, Salmon, Trout, Fish.

The well field serving the Lyons Ferry Fish Hatchery has experienced reduced water temperatures following continued, periodic withdrawal of large volumes of water. In January 1985, the well field temperature was 49 F, which is less than the optimal 52 F for raising salmon and steelhead trout. The aquifer supplying the hatchery is in hydraulic and thermal connection with the Snake River and a flooded embayment of the Palouse River. Groundwater temperatures in the well field cycle on an annual basis in response to changes in surface water temperature and pumping rate. Numerical simulation of the well field, using a simplified mixing cell model, demonstrates the coupling of well field hydraulics and aquifer thermal response. Alternative pumping schedules indicate that it is feasible to adjust groundwater pumping to effectively store head in the aquifer during the summer months when surface water temperatures are elevated. Sensitivity analysis of this model indicated that the primary controls of the system's thermal response are the volume of the aquifer assumed to contribute to the well field and temperature of the overlying surface water body. (Author's abstract)
W88-02388

DIGITAL SIMULATION MODEL FOR BRINE CONING IN UNCONFINED ANISOTROPIC AQUIFERS,
Centre for Water Resources Development and Management, Calicut (India).
S. P. Rajagopalan, and U. V. Jose.
Nordic Hydrology NOHYBB, Vol. 18, No. 1, p 43-58, 1987. 5 fig, 6 tab, 9 ref.

Descriptors: *Model studies, *Brines, *Aquifers, *Groundwater movement, *Simulation, *Saline water intrusion, Water table, Numerical analysis, Design criteria, Wells, Salinity.

A digital simulation model has been presented for locating the steady state stable brine cone position beneath partially penetrating wells tapping from the fresh water zone overlying a saline zone in an unconfined anisotropic aquifer. A graphical procedure has been converted into a numerical one and is used to successively approximate the brine cone and the depression in the water table are taken care of by repeated adjustment of the hydraulic conductances of the affected branches in the numerical model of the aquifer. An iterative version of the alternating direction implicit method has been used to solve the flow equations repeatedly till successively modified fresh water flow zones converge within a specified tolerance level. The results from the simulation model for a range of expected field conditions of aquifer, well and fluid density contrast have been presented in the form of graphs making use of appropriate non-dimensional parameters. These results can find applications in designing wells so that the discharge from those wells are limited to levels below which fresh water alone is drawn without any contamination by the underlying salt water. (Author's abstract)
W88-02441

BEHAVIOR OF HYDROPHOBIC, ORGANIC MICROPOLLUTANTS IN DIFFERENT KARST WATER SYSTEMS: I. TRANSPORT OF MICROPOLLUTANTS AND CONTAMINANT BALANCES DURING THE MELTING OF SNOW,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
For primary bibliographic entry see Field 5B.
W88-02480

BEHAVIOR OF HYDROPHOBIC, ORGANIC MICROPOLLUTANTS IN DIFFERENT KARST WATER SYSTEMS: II. FILTRATION CAPACITY OF KARST SYSTEMS AND POLLUTANT SINKS,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
For primary bibliographic entry see Field 5B.
W88-02481

2G. Water In Soils

THEORETICAL ANALYSIS OF THE TRANSIENT PRESSURE RESPONSE FROM A CONSTANT FLOW RATE HYDRAULIC CONDUCTIVITY TEST,
Geological Survey, Denver, CO.
R. H. Morin, and H. W. Olsen.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1461-1470, August 1987. 14 fig, 2 tab, 19 ref, 2 append.

Descriptors: *Soil water, *Water pressure, *Specific storage, *Permeability coefficient, *Data interpretation, Mathematical equations, Soil porosity, Pore pressure, Diffusion equation, Stress analysis, Fluid flow, Clays.

Incorporating a flow pump into a conventional laboratory system allows fluid to be supplied to or withdrawn from the base of a sediment sample at small and constant rates. An initial transient record of hydraulic head versus time is observed which eventually stabilizes to a constant steady state gradient across the sample; values of hydraulic conductivity can subsequently by determined from Darcy's Law. Analytical methods are presented for determining values of specific storage and hydraulic conductivity from the initial transient phase of such a constant flow rate test. These methods are based on a diffusion equation involving pore pressure, and are analogous to those used to describe the soil consolidation process and also to interpret aquifer properties from pumping tests. Examination of the effective stress distributions within the test specimen induced during this type of measurement shows that values of specific storage corresponding to both compression and rebound conditions can be deduced and differentiated simply by reversing the direction of fluid flow. Applicability and limitations of the methods are illustrated with analyses of recently reported flow pump test measurements conducted on a silty-clay specimen. (Author's abstract)
W88-01679

MACROSCOPIC AND MICROSCOPIC CAPILLARY LENGTH AND TIME SCALES FROM FIELD INFILTRATION,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
I. White, and M. J. Sully.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1514-1522, August 1987. 5 fig, 5 tab, 44 ref. Australian Water Research Council Grant 84/157.

Descriptors: *Infiltration, *Infiltration rate, *Soil water, *Soil properties, *Soil porosity, Sorption, Permeability coefficient, Capillarity, Capillary length scale, Capillary time scale, Porosity, Mathematical equations, Interstitial water, Flow profiles.

Estimates of characteristic times to approach steady state flow in multidimensional infiltration in the landscape depend on the magnitude and character of the capillary length scale lambda sub c and the associated capillary time scale t sub c. The relationships between lambda sub c and t sub c were derived and field properties sorptivity S and hydraulic conductivity K or S at two supply heads were measured. The relations between lambda sub c and t sub c and other macroscopic and microscopic length, potential and time scales were explored. In addition, it is shown that the microscopic characteristic length lambda sub m associated with lambda sub c gives physically plausible estimates of flow-weighted mean pore dimensions. Values of lambda sub c, t sub c, and lambda sub m for undisturbed field soils were contrasted with those of repacked materials for water supply potentials close to zero. Large lambda sub m for the undisturbed surface soils are attributed to preferential flow. Data from here and elsewhere reveal no apparent trend of lambda sub c with soil texture, with most lambda sub c of the order of 100 mm. It is suggested that the characteristic size of devices used to determine hydraulic properties of field soils should be greater than or equal to lambda sub c for representative measurements. The geometric mean time of approach to steady state flow when water is supplied at potentials near or greater than zero is found to be 1.7 hours. This value together with published results suggest that the time of approach to steady state flow from multidimensional cavities

is of the order of 1 hour for many field situations. (Wood-PTT)
W88-01684

SUBSURFACE WATER FLOW SIMULATED FOR HILLSLOPES WITH SPATIALLY DEPENDENT SOIL HYDRAULIC CHARACTERISTICS,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
M. L. Sharma, R. J. Luxmoore, R. DeAngelis, R. C. Ward, and G. T. Yeh.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1523-1530, August 1987. 9 fig, 3 tab, 26 ref. DOE Contract DE-AC-05-840R21400.

Descriptors: *Soil water, *Groundwater movement, *Seepage, *Flow discharge, *Simulation analysis, *Hillslopes, Data interpretation, Subsurface water, Storm seepage, Soil properties, Hydraulic properties, Richards' equation, Mathematical equations, Rainfall intensity, Rainfall, Flow patterns, Drainage.

Water flow through hillslopes consisting of five soil layers, with varying spatial dependence in hydraulic characteristics in the lateral plane was simulated by solving Richards' equation in three dimensions under varying rainfall intensities and for two complexities of terrain. By concepts of similar media the variability in soil hydraulic characteristics was expressed by a single dimensionless parameter, the scaling factor alpha. The moments of log normally distributed alpha were set as: Mean = 1.0 and standard deviation = 1.0. Four cases of spatial dependence of alpha in the lateral plane were selected for simulation, using exponential variogram functions ranging in spatial structure from random (no spatial dependence) to large dependence (large correlation lengths). The simulations showed that the rates of subsurface flow from the 30 degree hillslope, during and following rainfall, were significantly enhanced with an increase in spatial dependence. Subsurface drainage was also increased with increases in rainfall intensity and slope complexity. For hillslopes, the relative effect of spatial dependence in soil hydraulic characteristics was smaller with 30 degrees horizontal pitching than without pitching. Hillslopes with a random distribution of hydraulic characteristics provided greater opportunity for soil units with differing water capacities to interact than in cases with spatially correlated distributions. This greater interaction is associated with a greater lag in subsurface flow generation. This illustrates some of the expected effects of spatial dependence of soil hydraulic characteristics on the integrated hydrologic response of land areas. (Author's abstract)
W88-01685

NEW METHOD FOR CALCULATING FROST HEAVE INCLUDING SOLUTE EFFECTS,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 2C.
W88-01693

TWO- AND THREE-DIMENSIONAL STEADY QUASI-LINEAR INFILTRATION FROM BURIED AND SURFACE CAVITIES USING BOUNDARY ELEMENT TECHNIQUES,
Auckland Univ. (New Zealand). Dept. of Theoretical and Applied Mechanics.
A. J. Pullan, and I. F. Collins.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1633-1644, August 1987. 12 fig, 4 tab, 34 ref, append.

Descriptors: *Infiltration, *Soil water, *Cavities, *Numerical methods, *Mathematical studies, *Boundary element techniques, Boundary processes, Mathematical equations, Porous media, Capillarity, Gravity, Flow discharge.

A general numerical method is presented for solving the problem of quasi-linearized steady infiltration from general two-dimensional and axisymmetric surface cavities and from a general cavity buried at an arbitrary depth in either a two- or three-dimensional semi-infinite porous medium. Numerical results are compared with known analytical results for the cases of a shallow circular pond and a circular cylindrical cavity and a spherical cavity buried in an infinite medium. Further results are presented graphically illustrating the effect of an upper surface on the flux from a circular cavity and also the effect on the size of the effective wetted region. Two-dimensional surface cavities are also investigated, and the dependence of the flux on geometry, gravity, and capillarity is examined. (Author's abstract)
W88-01695

SOIL--AN UNCERTAIN MEDIUM FOR WASTE DISPOSAL,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5B.
W88-01746

METHOD FOR STRENGTHENING SOFT SOIL,
Chiyoda Chemical Engineering and Construction Co. (Japan).
H. Miyoshi, E. Asanagi, J. Iguchi, and I. Okabayashi.
U.S. Patent No. 4,443,260; April 17, 1984. 9 p, 3 fig, 3 tab. Official Gazette of the United States Patent Office, Vol 1041, No 3, p 1177, April 17, 1984.

Descriptors: *Dredge spoil disposal, *Patents, *Soil strength, *Soil treatment, *Saturated soils, *Additives, Soil water, Gypsum, Iron, Portland cements, Transportation, Dredging.

Admixed water-saturated soft soil on sea or river beds is strengthened to improve transportation on reclaimed soft grounds formed by dredging of such soil. A total of 5-45% by weight particulate gypsum and 55-95% by weight of water-granulated iron blast furnace slag having a particle size of 1-100 micrometers is premixed to obtain a first homogeneous admixture of slag and gypsum particles. The first admixture with the soft soil is admixed to obtain a second homogeneous admixture; and a Portland cement is admixed with the second admixture in an amount to provide a weight ratio of the first admixture to the Portland cement of 75/25 to 55/45. The time required to obtain a homogeneous mix with the soil is less than when the slag is premixed with the cement. (Cremmins-AEPCO)
W88-01779

EXPERIMENTAL STUDY OF SOLUTE TRANSPORT IN A STONY FIELD SOIL,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
For primary bibliographic entry see Field 5B.
W88-01919

COMPUTERIZED SOIL DATA USED IN AGRICULTURAL WATER PLANNING, DENMARK.
Copenhagen Univ. (Denmark).
For primary bibliographic entry see Field 7C.
W88-01921

USE OF SOIL AND CLIMATIC DATA TO PREDICT HYDRAULIC LOADING BEHAVIOUR OF IRISH SOILS,
Kinsealy Research Centre, Dublin (Ireland).
M. J. Gardiner.
Soil Use and Management, Vol. 2, No. 4, p 146-149, December 1986. 2 fig, 2 tab, 7 ref.

Descriptors: *Hydraulic loading, *Soil water potential, *Soil properties, *Climatic data, *Soil types, Soil moisture deficiency, Soil water, Soil physical properties, Permeability coefficient, Porosity, Infiltration capacity, Precipitation, Evapotranspiration, Ireland, Effluent limitations.

Absolute and temporal individual soil hydraulic loading limits under Irish conditions were estimated from soil and climatic data. The most influential soil properties are hydraulic conductivity, infiltration capacity, drainable porosity and field capacity. The most important climatic parameters are precipitation and evapotranspiration. Therefore, the concepts of cumulative soil moisture deficit (CSMD), (the amount of water needed to restore soil to field capacity as calculated from the running total difference between rainfall and potential evapotranspiration), and winter rain acceptance (WRAP) were measured. CSMD, which can be used as a general guideline for determining how much fluid a soil can accept before reaching field capacity, ranged from 116 mm in the southeast to 2 mm in the northwest. The soil moisture deficit periods were determined for four regions and it was concluded that hydraulic loading was unlikely to occur during these periods under normal farm practices in the various regions. WRAP, which depends on the soil water regime, the depth to an impermeable layer, the permeability of the soil horizons above the impermeable layer, and the slope, was used to assess the possibilities of farm effluent disposal outside the CSMD period under field capacity or saturated conditions. It was found that about 49% of the soils in Ireland have a very high to moderate WRAP, and 36% have low or very low WRAP; the latter soils are likely to exhibit problems if effluents are applied outside the CSMD period. Regional farm slurry storage duration requirements were estimated from CSMD and WRAP data. (Wood-PTT)
W88-01922

STATISTICAL EVALUATION OF DRAINAGE TREATMENTS IN SIMPLE FIELD TRIALS WITH SPECIAL REFERENCE TO FORMER OPENCAST COAL MINING LAND,
University Coll. of Wales, Llanelly. Field Lab.
J. Scullion, A. R. A. Mohammed, and G. A. Ramshaw.
Journal of Agricultural Science, Cambridge JASIAB, Vol. 107, Part 3, p 515-520, December 1986. 1 fig, 5 tab, 19 ref.

Descriptors: *Drainage practices, *Surface-groundwater relations, *Surface water management, *Statistical analysis, Water management, Mathematical studies, Field tests, Coal mining, Drainage, Soil water, Regression analysis, Drainage response patterns, Rainfall.

Drainage trials frequently lack any statistical evaluation of treatment differences, often because of practical difficulties in setting up randomized field experiments. Also, where detailed moisture measurements are carried out, the usefulness of such data is small in relation to the workload involved. Procedures are described which seek to rectify, in part, these limitations. Routine drain and surface condition data were analyzed. Parallel regression analysis was used to compare drainage response patterns based on linear relationships between rainfall and peak drain flow. A point scoring system allowed treatment effects on surface conditions to be evaluated by chi-square analysis. Artificial drainage seeks to simulate naturally free-draining conditions. In line with this objective, soil moisture contents in the field, on a 'Field Capacity Day', were related to those at a standard (-10 KPa) moisture tension typical of free-draining reference sites. Effectiveness of drainage performance was indicated by proximity of field and reference tension moisture contents. Worked examples of each of the procedures are provided. The procedures were both sensitive and complementary. The value of the overall approach and its application under more normal agricultural conditions are discussed. (Author's abstract)
W88-01923

FIELD DRAINAGE EXPERIMENTS AND DESIGN ON FORMER OPENCAST COAL MINING LAND,
University Coll. of Wales, Llanelly. Field Lab.
J. Scullion, and A. R. A. Mohammed.
Journal of Agricultural Science, Cambridge JASIAB, Vol. 107, Part 3, p 521-528, December 1986. 3 fig, 4 tab, 25 ref.

Descriptors: *Surface-groundwater relations, *Drainage engineering, *Drainage, *Soil properties, *Surface water management, *Water manage-

ment, Design criteria, Coal mining, Subsoiling, Drain spacing, Drainage practices, Statistical analysis, Subsoil drainage.

A series of drainage trials was set up to investigate various aspects of drainage design on former opencast coal mining land. The drainage problem was characterized. Subsoiling, subsoiling direction with respect to slope, and drain spacing were assessed as factors affecting drainage performance. The persistence of subsoiling effectiveness was also monitored. Drainage performances were evaluated statistically. Surface wetness was the predominant feature of drainage conditions on opencast land and the effectiveness of drainage treatments was limited to the control of this superficial water. Secondary drainage, in this case subsoiling, was an essential feature of field drainage, reducing surface wetness and runoff. The effectiveness of subsoiling was dependent on there being sufficient gradient (4-5%) along channels for intercepted water to clear. For this reason, adoption of appropriate minimum reinstatement gradients and the arrangement of field drains to accommodate preferred directions of secondary treatments would assist drainage effectiveness. There was a gradual deterioration in drainage performance as spacing increased. Spacings in the range of 20-30 meters appeared to offer a reasonable compromise between cost and benefit. The persistence of subsoiling treatments, which deteriorated markedly after 2-4 years, was not affected by drain spacing. Performance at the widest spacings tested, was, however, generally poor regardless of time since subsoiling. A basis for calculating design rates on individual sites and the implications for drainage theory of soil air-water interactions are discussed. (Author's abstract)
W88-01924

APPLICATION OF INFILTRATION EQUATIONS TO A CATCHMENT WITH LARGE SPATIAL VARIABILITY IN INFILTRATION,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 2A.
W88-01969

LAKE PERCHED ON PISCINE PERIL,
Coventry (Lanchester) Polytechnic (England).
I. Payne.
New Scientist NWSCAL, Vol. 115, No. 1575, p 50-54, August 27, 1987.

Descriptors: *Lake Victoria, *Nile perch, *Species diversity, *Limnology, Environmental effects, Ecological balance, Ecosystems, Food habits, Food chains.

Lake Victoria once supported a vast variety of fish, many unique to its waters. After the Nile perch moved in, all this changed. Many species of local fish have disappeared and, overall, numbers are dropping rapidly. In contrast, the Nile perch has flourished. Its disastrous effect on the lake's fish shows the danger of introducing an unchallenged predator. One solution to the problem may be the fish's appetite: it could eat all the available food and still starve to death. In 30 years, since the fish was first found in Lake Victoria, the population of Nile perch has grown so large that the usurpers make up 80% of the fish in the lake. Nile perch appeared in Kenyan waters in 1966 where its expansion was, again, explosive. In the Nyanza Gulf, which lies in the northeast of Lake Victoria, 60% of the catch was perch by 1981. However, conditions in the gulf are ideal for the Nile perch, as the water is shallow. In open waters, the proportion of perch was about half this. Eventually, the Nile perch reached the southern half of the lake. It appeared in the waters off Tanzania in 1978. By 1982, it constituted 6.4% of the Tanzanian catch. As the Nile perch established itself in the lake, it preyed mainly on the small cichlids. The numbers of these declined rapidly. In Kenyan waters, catches of small cichlids have fallen to the point where, in 1981, they made up only 4% of the catch. Other fish, as well as the cichlids, have declined in the face of the incursions by the Nile perch. A catfish, Bagrus, for example, was the main predator of the cichlids before the perch moved in on its territory. Scientists estimate that this predator ate about 70% of the haplochromines each year. The answer to the problem of the Nile perch is to fish it away, to give other fish a chance. This is one of the few times when fishery scientists can recommend that people exploit a particular species as soon as possible. No one can predict the extent to which catches will stay at the same level. The Nile perch is a predator and its explosive growth depends on a hugh population of small fish for prey and an absence of any serious competition as a predator. (Lantz-PTT)
W88-01989

PREDICTION OF NITROGEN AND PHOSPHORUS LOSSES AS RELATED TO AGRICULTURAL DRAINAGE SYSTEM DESIGN,
North Carolina State Univ. at Raleigh. School of Agriculture and Life Sciences.
S. C. Deal, J. W. Gilliam, R. W. Skaggs, and K. D. Konyha.
Agriculture, Ecosystems and Environment, Vol. 18, No. 1, p 37-51, 1986. 8 tab, 14 ref.

Descriptors: *Nitrogen, *Phosphorus, *Drainage systems, *Drainage engineering, *Controlled drainage, *Agriculture, Prediction, Engineering, Nutrients, North Carolina, Computers, Simulation analysis, Drainage, Subsurface drainage, Nitrates, Simulation, Soil types.

The effects of differing degrees of improved agricultural drainage was determined on the long-term efflux of N and P from poorly drained soils of the North Carolina Coastal Plain. The effect of using controlled drainage on efflux was also investigated. Computer simulations were used to predict the losses from six soils for a 20-year period, indicating that drainage system design and management can have significant effects upon N and P efflux in drainage water. Drainage systems designed to give good subsurface drainage lost 17-35 kg/ha/yr more NO3-N than systems with poor subsurface drainage. Good subsurface drainage decreased total P lost by 0.2-0.4 kg/ha/yr on the mineral soils studied. The increase in N lost through subsurface drainage can partially be offset by controlled drainage. Under the conditions simulated in this study, controlled drainage reduced the nitrate efflux by as much as 34%, depending on soil and management conditions. Controlled drainage does, however, result in a small increase in P efflux under the conditions simulated. (Author's abstract)
W88-02071

SOLUBLE SALT CONTENT OF THE ALLUVIAL BANKS OF A SEMI-ARID TRIBUTARY CATCHMENT OF THE GREAT FISH RIVER,
Rhodes Univ., Grahamstown (South Africa). Hydrological Research Unit.
D. A. Hughes, and J. H. Moolman.
Water SA, Vol. 13, No. 2, p 81-86, April 1987. 3 fig, 1 tab, 13 ref.

Descriptors: *Salinity, *Catchments, *Saline soil, *Alluvial channels, *Rainfall-runoff relationships, Runoff, Rainfall, Semi-arid climates, River systems, Solute transport, Great Fish River.

Soil samples were collected from a number of different channel bank locations within the Ecca catchment in the semi-arid eastern Cape Province, Republic of South Africa. At each location, samples were taken at different heights of the vertical bank section and at a series of horizontal depths into the banks. The electrical conductivity (EC) of the water-saturated extracts was used as an index of soluble salt content and the logarithmically transformed data subjected to analysis of variance. EC values were found to be variable and apart from a generalized increase with vertical depth, no spatial structure was evident. The variable nature of the data collected from this undisturbed (i. e. uncultivated) catchment suggests that the movement of water and salt into and out of the river banks is very localized, possibly due to the presence of preferential flowpaths. Surface salt accumulation on the banks of the Ecca River does not appear to be a widespread phenomenon. The general absence of salt efflorescence on the river bank, and the increase in salt content with depth down the bank, may be related to the two types of rainstorms which prevail in this catchement. (Airone-PTT)
W88-02090

KINETICS OF WATER VAPOR ADSORPTION ON SOILS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
M. E. Grismer.
Soil Science SOSCAK, Vol. 143, No. 5, p 367-371, May 1987. 7 fig, 1 tab, 14 ref.

Descriptors: *Water vapor, *Soil water, *Adsorption, *Kinetics, *Soil texture, *Model studies, Soil types, Bentonite, Clays, Hygroscopic waters, Soil solution.

Water vapor transport and adsorption may be a significant factor in solution movement through relatively dry fine-textured soils. An experimental procedure capable of monitoring the temporal dependence of the vapor adsorption is presented. Results from several experiments conducted on two bentonite samples were collapsed into a coincident set of curves through normalization of the time axis by the sample mass. Additional experiments were also conducted on two fine-textured soils. From the normalized data it was possible to model the kinetic adsorption process by a hyperbolic type function that depends upon the initial adsorption rate and equilibrium water content of the particular soil. Such dependence suggested that mechanisms involved in physical adsorption of water vapor are common to most soils. (Author's abstract)
W88-02329

WATER UPTAKE BY ROOTS IN CRACKS AND WATER MOVEMENT IN CLAYEY SUBSOIL,
National Research Inst. of Agricultural Engineering, Yatabe (Japan).
For primary bibliographic entry see Field 2I.
W88-02330

MODELING THE FLOW OF IMMISCIBLE FLUIDS IN SOILS,
National Chunghsing Univ., Taichung (Taiwan). Dept. of Soil Science.
C. Lin.
Soil Science SOSCAK, Vol. 143, No. 4, p 293-300, April 1987. 1 fig, 12 ref.

Descriptors: *Soil water, *Path of pollutants, *Model studies, *Immiscibility, *Mathematical equations, Simulation, Flow, Trichloroethylene, Sand, Equations.

A model for the flow of two incompressible and immiscible fluids in soils, developed by combining a modified Darcy's law with the continuity equations is reported. The resulting equations are of a system of nonlinear partial differential equations. Numerical analysis, based on the finite element method and Newton-Raphson's method, to solve the equations is given and discussed. Computer simulations of the flow of water and trichloroethylene in sands are also shown. (Author's abstract)
W88-02360

SOIL NUTRIENT LEACHING IN RESPONSE TO SIMULATED ACID RAIN TREATMENT,
Tennessee Valley Authority, Chattanooga. Div. of Air and Water Resources.
For primary bibliographic entry see Field 5C.
W88-02458

2H. Lakes

ECOLOGY OF THE COASTAL MARSHES OF WESTERN LAKE ERIE: A COMMUNITY PROFILE,
Ohio State Univ., Columbus. Center for Lake Erie Area Research.
C. E. Herdendorf.
Biological Report 85(7.9), February 1987. 171 p, 92 fig, 31 tab, 253 ref, 13 append.

Descriptors: *Lake Erie, *Ecology, *Wetlands, *Coastal marshes, Ecosystems, Great Lakes, Ecological distribution, Fish, Mammals, Birds, Invertebrates.

Lake Erie, the southernmost of the Laurentian Great Lakes, is narrow and relatively shallow in comparison to other Great Lakes. The lake experiences extreme water level fluctuations and storm energy restricts the development of wetlands to protected areas within embayments, lagoons, or behind barriers. However, coastal marshes of western Lake Erie fringe the shorelines of Michigan, Ohio, and Ontario and encompass an area of 268 sq km. This publication reviews the ecological data and information on the wetlands of Lake Erie, which are some of the more productive areas in the Great Lakes ecosystem. The geologic history of Lake Erie leading to the development of wetlands, the present environment, and present wetland distribution is presented as background in the opening chapters. Biological information available for the Lake Erie wetlands, biological production, and community organization in the wetlands are examined. A chapter on applied ecology addressing issues such as wetland loss, values of wetlands to fish and wildlife, management, and future prospects for Lake Erie wetlands completes the publication. (Author's abstract)
W88-01610

BLUE MESA RESERVOIR, COLORADO: A HISTORICAL REVIEW OF ITS LIMNOLOGY, 1965-1985,
Bureau of Reclamation, Denver, CO. Applied Sciences Branch.
L. S. Cudlip, R. D. French, and D. Hickman.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB87-219283, A04 in paper copy, A01 in microfiche. Report No. REC-ERC-87-3, June 1987. 59 p, 17 fig, 13 tab, 81 ref, append.

Descriptors: *Limnology, *Blue Mesa Reservoir, *Colorado, *Literature review, History, Biological properties, Chemical properties, Physical properties, Ecology.

Twenty years of biological, chemical, and physical data from Blue Mesa Reservoir, Colorado, were analyzed to elucidate the process of impoundment maturation in Bureau of Reclamation reservoirs. Blue Mesa Reservoir was chosen for two reasons: (1) the impoundment is 20 years old, and should have attained trophic equilibrium, and (2) there is a relatively large amount of data with which to assess the impoundment's biological, chemical, and physical structure and function over time. Blue Mesa Reservoir's limnology has been studied since impoundment in 1965. Much of the initial work was performed by Colorado Division of Wildlife personnel; later work was conducted by the Environmental Protection Agency and National Park Service. The most recent work, contracted by the Bureau of Reclamation, culminates 20 years of study. The data were analyzed for historical trends. Evidence of such trends was interpreted and used to assess present reservoir trophy, to predict future reservoir trends, and to indicate future management possibilities. (Author's abstract)
W88-01665

QUANTITATIVE COMPARISON OF FOOD NICHES IN SOME FRESHWATER ZOOPLANKTON: A MULTI-TRACER-CELL APPROACH,
Dartmouth Coll., Hanover, NH. Dept. of Biological Sciences.
K. G. Bogdan, and J. J. Gilbert.
Oecologia OECOBX, Vol. 72, No. 3, p 331-340, June 1987. 4 fig, 4 tab, 18 ref. NSF Grants DEB 8119213 and BSR 8415024.

Descriptors: *Zooplankton, *Food niches, *Freshwater, *Food habits, *Zooplankton, Aquatic animals, Foods, Behavior, Plankton, Tracers, Isotopic tracers, Rotifers, Cladocerans, Copepods, Correlation coefficient, Food chains, Algae.

The abilities of some zooplankton (rotifers, cladocerans, copepods) to ingest different sizes and kinds of food cells were quantified by determining the relative efficiencies with which they ingested nine tracer-cell types, ranging from a coccoid bacterium (0.45 cu micrometers) to the alga Cryptomonas erosa (800-920 cu micrometers). These efficiencies were obtained by dividing the clearance rate of each zooplankton group (species, population, developmental stage or size class of a species population) on each P32-labeled cell type by that of a simultaneously-offered, P33-labeled, standard cell type - Chlamydomonas reinhardtii. Similarities of efficiency patterns on these cell types (food niches) between all possible pairs of the 17 zooplankton groups from four ecosystems were determined by calculating correlation coefficients. Although the utilization of the tested cell types may vary greatly within a species, three feeding guilds could be distinguished based primarily on the efficiencies with which the smallest types were ingested. Principal component analysis of the matrix of correlation coefficients provided objective confirmation of the three guilds and provided a visual representation of the food niches of the 17 zooplankton groups in three-dimensional space. (Wood-PTT)
W88-01704

MIRE DEVELOPMENT, POOL FORMATION AND LANDSCAPE PROCESSES ON PATTERNED FENS IN DALARNA, CENTRAL SWEDEN,
Harvard Univ., Petersham, MA. Harvard Forest.
D. R. Foster, and S. C. Fritz.
Journal of Ecology JECOAB, Vol. 75, No. 2, p 409-437, June 1987. 25 fig, 5 tab, 78 ref.

Descriptors: *Pool formation, *Paleoecology, *Mire development, *Ephemeral pools, *Geomorphology, *Ponds, Dalarna, Sweden, Topography, Topographic mapping, Terrain analysis, Drainage, Fens, Wetlands, Ecosystems.

Mire development and pool formation were examined stratigraphically on patterned fens in Dalarna, central Sweden. The paleoecological study was complimented by mapping of the surface and substratum topography, description of modern landforms, analysis of the water chemistry and diatom flora, and phytosociological study of the vegetation. Forty-three releves are organized into seven noda, which separate along a moisture gradient. The major landforms include mire-margin hummocks, pine islands, ridges, flarks, mud bottoms, and open-water pools. Peat cores along a 900 m transect from the base to the top of one fen slope show that the mire developed through upslope paludification. Basal radiocarbon dates decrease sequentially from 9040 + or - 80 years B.P. at the base of the slope to 1640 + or - 50 years B.P. at a point 100 m from the top ot the fen. Buried forest soils and stumps of Pinus sylvestris at the base of the peat indicate that forest communities were replaced by sedge fen. Pools and ridges develop through gradual differentiation of the mire surface some thousands of years following mire initiation. Deep pools are underlain by more than 1 m of algal gyttja, which grades downward into peat detritus and then peat. Radiocarbon-dated profiles indicate that pools initially deepen through peat degradation before the deposition of algal sediment starts. The surface patterning is dynamic. The total pool area on the mire increases with time and the size, shape and orientation of individual pools may change. Pools expand through gradual submergence of marginal areas as well as through coalescence. Pool drainage may occur through coalescence of pools at different elevations, through ridge erosion, and through subsurface piping. The overall development of the mires involves progressive diversification on two scales. The regional landscape increases in complexity and landform diversity as mires form and replace forest communities. On the mires, local diversification involves the development and alteration of surface features through time. (Author's abstract)
W88-01708

DISTRIBUTION OF STREAM-EDGE VEGETATION ALONG A GRADIENT OF CURRENT VELOCITY,
Umea Univ. (Sweden). Dept. of Ecological Botany.
C. Nilsson.
Journal of Ecology JECOAB, Vol. 75, No. 2, p 513-522, June 1987. 4 fig, 51 ref.

Descriptors: *Plant populations, *Stream banks, *Flow velocity, *Streams, *Water currents, Surface flow, Sweden, Aquatic plants, Riparian vegetation, Habitats, Vegetation, Aquatic habitats, Distribution patterns, Streamflow.

Natural physical disturbance plays an important role in shaping plant community structure along streams. It is difficult to integrate all types and scales of disturbance in a single measure. Current velocity at the surface in mid-stream was used as an estimate and floristic patterns in the aquatic and riparian plant communities were examined along the gradient obtained. The study was made along a northern Swedish stream. The number of species in the water reached a peak at an intermediate current velocity, whereas that in the riparian belt showed an overall increase with current velocity. In both habitats substratum changed from mainly organic to inorganic at an intermediate current velocity. The zone where substratum changed coincided with the major change between communities. Here utilization of space was at its maximum. The role of site disturbance in producing these patterns is discussed. It is suggested that soil analyses alone may be useful for identifying disturbance gradients associated with both flow and wave action along a watercourse. (Author's abstract)
W88-01709

PRESENCE OF ERWINIA CAROTOVORA IN SURFACE WATER IN NORTH AMERICA,
Colorado State Univ., Fort Collins. Dept. of Plant Pathology and Weed Science.
M. D. Harrison, G. D. Franc, D. A. Maddox, J. E. Michaud, and N. J. McCarter-Zorner.
Journal of Applied Bacteriology JABAA4, Vol. 62, No. 6, p 565-570, June 1987. 3 tab, 18 ref.

Descriptors: *Pollutant identification, *Rivers, *Lakes, *Bacteria, *Erwinia carotovora, Water pollution, Surface water, Pollutants, Springs, Creeks, Streams, Reservoirs, Ponds, Potatoes, United States, Canada, Microbiological studies.

Erwinia carotovora was frequently isolated from samples of surface water collected from 66 rivers, springs, creeks, streams, lakes, reservoirs and ponds in 16 states in the US, but was not found in the single fresh water sample collected in Canada. The organism was also isolated from water collected from the Pacific Ocean and the Gulf of Mexico. In Colorado and Wyoming, E. carotovora was isolated from water samples nearly every month of the year when monthly samples were collected from several streams. Erwinia carotovora subsp. carotovora represented 98.8% of the strains recovered from the water samples; E. carotovora subsp. atroseptica made up the remainder of the strains; E. chrysanthemi was not found. (Author's abstract)
W88-01711

EVALUATION OF THE SATURATION APPROACH TO MEASUREMENT OF VMAX FOR GLUCOSE MINERALIZATION BY EPILITHIC FRESHWATER BACTERIA,
Hull Univ. (England). Dept. of Plant Biology.
R. Goulder.
Letters in Applied Microbiology, Vol. 4, No. 2, p 29-32, 1987. 1 fig, 1 tab, 11 ref.

Descriptors: *Aquatic bacteria, *Heterotrophic bacteria, *Microbiological studies, Bacteria, Mineralization, Glucose, Biochemistry, Epilithion.

The heterotrophic activity of natural populations of suspended aquatic bacteria is frequently investigated by measurement of utilization (assimilation and/or mineralization) of radiolabelled organic substrates. Three analytical approaches have been used; kinetic, trace addition, and single substrate concentration/saturation. This study considers whether saturation of bacterial glucose mineralization in epilithion suspensions can be achieved, al-

lowing estimation of V sub max (the potential utilization rate achievable at saturation substrate concentration) by incubation at a single, saturation substrate concentration. The glucose mineralization rate by epilithion from calcareous streams increased with an increase in added glucose concentration, and a straight line relationship was established. With epilithion from acid streams, saturation was achieved. V sub max could then be estimated by incubation at a single substrate concentration, but only if achievement of saturation can be demonstrated. The method may be appropriate only at certain seasons, i.e., it might not be suitable during low summer flow when pH is close to neutral and epilithic filamentous algae are abundant. (McFarlane-PTT)
W88-01803

RELATIONS BETWEEN AQUATIC PLANT COMMUNITIES AND LAKE CHARACTERISTICS ON MACQUARIE ISLAND,
Tasmania Univ., Hobart (Australia). Dept. of Geography.
J. M. R. Hughes.
New Zealand Journal of Botany NZJBAS, Vol. 24, No. 2, p 271-278, 1986. 3 fig, 3 tab, 29 ref.

Descriptors: *Cold regions, *Lakes, *Aquatic plants, *Macquarie Island, Rooted aquatic plants, Eutrophic lakes, Oligotrophic lakes, Myriophyllum, Biomass, Water quality, Limnology.

An understanding of the relationships between aquatic plant communities and lake characteristics on subantarctic islands is of great importance for their conservation, for reconstructing past climates using pollen from aquatic species, and for monitoring changes in subantarctic lake ecosystems. Described is the marginal and aquatic vegetation of 5 lakes on Macquarie Island, investigating the relationships between water quality, substrate characteristics, and the plant communities of these lakes. Two lakes have nutrient-rich waters and organic substrates while the other 3 are oligotrophic with coarse inorganic substrates. Myriophyllum triphyllum is widespread in the nutrient-rich lakes, along with aquatic bryophytes and algae. Aquatic angiosperms are mostly absent from the oligotrophic lakes. It is suggested that the greater biomass in some of the lakes is due to nutrients derived from deposition of sediment from the surrounding basin. (McFarlane-PTT)
W88-01805

INFERENCES FROM SPATIAL AND TEMPORAL VARIABILITY IN ECOSYSTEMS: LONG-TERM ZOOPLANKTON DATA FROM LAKES,
Wisconsin Univ.-Madison. Center for Limnology.
T. K. Kratz, T. M. Frost, and J. J. Magnuson.
American Naturalist AMNTA4, Vol. 129, No. 6, p 830-846, June 1987. 5 fig, 4 tab, 30 ref. NSF Grant DEB 8012313 and Little Rock Lake Experimental Acidification Project (CR812216-01-0) (cooperative agreement with U.S. EPA).

Descriptors: *Spatial distribution, *Temporal distribution, *Zooplankton, *Ecosystems, *Lakes, Ecological distribution, Species diversity, Rotifers, Copepods, Cladocerans.

Ecosystem patterns and processes exhibit spatial and temporal variability. Analysis of this variability can reveal which aspects of a system are specific to sites or years. Patterns in this variability yield insights into the forces structuring ecosystems. An unpublished zooplankton data set collected in the summers of 1929-1941 from five neighboring northern Wisconsin lakes is examined. Eight taxa common to the five lakes were two rotifers, four cladocerans, and two copepods. Taxa differed in their consistency in depth distribution and seasonal timing. Among-year variability was greater in zooplankton abundance than in seasonal timing, which, in turn, was more variable than depth distribution. Among-year variability in maximum abundance was related to a taxon's potential for rapid population increase. Variability among years was greater in rotifer taxa than in cladoceran taxa, which were more variable than copepod taxa. Conditions specific to lakes appear to be important in controlling the abundance and depth distribution of copepods and cladocerans. In contrast, it is inferred that weather variation was an important determinant of seasonal timing for all eight taxa. An ability to predict general site-specific and year-specific ecosystem parameters has significant practical and theoretical implications. An analysis of spatial and temporal variability could provide useful comparisons of ecosystems, ranging from aquatic to terrestrial habitats and comprising markedly different taxa. (Airone-PTT)
W88-01816

STRUCTURE AND FUNCTION OF DETRITUS IN AQUATIC ECOLOGICAL SYSTEMS,
I. I. Vorovich, Y. A. Dombrovskii, Y. A. Zhdanov, V. G. Il'ichev, and F. A. Surkov.
Doklady Biological Sciences DKBSAS, Vol. 291, No. 1-6, p 648-651, May 1987. 2 fig, 12 ref. Translated from Doklady Akademii Nauk SSSR, Vol. 291, No. 2, p 488-491, November 1986.

Descriptors: *Detritus, *Kinetics, *Ecosystems, *Limnology, Organic matter, Phosphorus, Decomposition, Simulation analysis.

Some theoretical-ecological and hydrobiological principles determined from analysis of a simulative system of the Azov Sea are presented. The process of decomposition of organic compounds is one of the most important links in the overall cycling of matter in aquatic ecological systems. The kinetics of the process of destruction of organic matter (OM) in natural waters is extremely complex. Natural and laboratory investigations have shown the theoretical possibility of adequately approximating the kinetics of OM decomposition in the form of some sequence of first-order reactions. Within this framework, a model for detritus is briefly described. Some principles are outlined which follow from this model, and corresponding parameters which affect phytocoenesis stability are indicated. (Airone-PTT)
W88-01817

TRANSFORMATION OF LAKE ZOOPLANKTON IN RIVERS,
Akademiya Nauk SSSR, Leningrad. Zoologicheskii Inst.
I. V. Telesh.
Doklady Biological Sciences DKDSAS, Vol. 291, No. 1-6, p 656-659, May 1987. 3 fig, 14 ref. Translated from Doklady Akademii Nauk SSSR, Vol. 291, No. 2, p 495-498, November 1986.

Descriptors: *Plankton, *River flow, *Turbidity, *Mathematical analysis, River systems, Lakes, Self-purification, Crustaceans, Ecosystem, Copepods, Rotifers, Mathematical equations, Flow velocity, Neva River.

Information about the fate of lake plankton in different sections of rivers is of great value for clarifying formation patterns of potamoplankton, biological productivity and self-purification of currents, and their rational utilization. In the course of two voyages, July 18 and September 11, 1985, samples of zooplankton were collected in Petrokrepost' Bay of Lake Ladoga, at ten stations along the entire course of the Neva and in Neva Bay of the Gulf of Finland. In July, total biomass of netted zooplankton in Petrokrepost' Bay constituted 3.35 g/cu m, and the larger part of it consisted of cladoceran crustaceans, 2.90 g/cu m (copepods 0.43 and rotifers 0.015 g/cu m; respectively). In September total netted biomass was 0.32 g/cu m. Copepods dominated (0.17 g/cu m. Cladocerans yielded 0.11 g/cu m and rotifers measured 0.032 g/cu m). According to biomass, only 1% of cladocerans and 10% of copepod crustaceans, primarily young, of those which entered the Neva from Ladoga waters reach Neva Bay. The strongest loss of biomass occurred at the source and in the upper course of the Neva. A sharp change in environmental conditions, caused by increased flow rate and turbidity, was the reason for this loss (in summer, Petrokrepost' Bay is filled with coastal water masses of increased particle content with terrestrial origin). The dependency of zooplankton biomass at any point in the first 50 km of the river's course away from the source at different rates of flow was determined. The general equation is: B sub s = B sub zero times e to the KS power, where B sub s is zooplankton biomass at a point S km from the source of the river, B sub zero is zooplankton biomass at the river source, and K is an angular coefficient which shows how biomass changes per km of the river's course. For the Neva, zooplankton biomass is reduced 6.6% km. It has been established that reduction in zooplankton concentration in a river channel occurs in a regular way under the influence of conditions characteristic of the river, such as water flow, presence of mineral suspensions, and so on. (Airone-PTT)
W88-01818

PERFORMANCE OF A NATURAL WETLAND TREATMENT SYSTEM FOR WASTEWATER MANAGEMENT,
CH2M Hill, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5D.
W88-01822

TWO SIMPLE MODELS FOR ESTIMATING DAILY MEAN WATER TEMPERATURES AND DIEL VARIATIONS IN A DANISH LOW GRADIENT STREAM,
Miljoestyrelsen, Silkeborg (Denmark). Freshwater Lab.
E. Jeppesen, and T. M. Iversen.
Oikos OIKSAA, Vol. 49, No. 2, p 149-155, June 1987. 7 fig, 2 tab, 30 ref.

Descriptors: *Denmark, *Streams, *Water temperature, *Model studies, *Diel variation, Regression analysis, Air temperatures, Radiation, Simulation analysis.

The Danish River Susa was studied in a third to fourth order low gradient reach with a large summer biomass of macrophytes. In a simple model daily mean water temperature was described as a function of daily mean air temperature at the two localities studied. A linear regression analysis showed that the slopes of the two regression lines were significantly different, which could be explained by the relative proportion of incoming groundwater. A simple model for estimating the diel variations in stream water temperature was established from submodels of incoming and outgoing radiation and of the exchange of heat, mainly with the atmosphere. The only input to the model is air temperature and photosynthetic active radiation, PAR. Two parameters, A sub sol and A sub con were calibrated. The parameter A sub sol expresses the proportion of PAR used to heat the water. At the upstream locality A sub sol varied with season due to shading from the herbaceous bank vegetation, whereas A sub sol at the downstream locality was constant. A sub con expresses the rate of heat exchange between air and water, and is linearly related to the reaeration coefficient, which was estimated independently. The model simulated the diel variations in water temperatures quite accurately. Even on days when air temperature and PAR showed large fluctuations the simulated water temperatures deviated less than 1 C from actual measurements during 90% of the time. Using the model at the downstream reach, with an average A sub sol and A sub con as estimated from the reaeration coefficient, simulated temperatures never deviated more than 2 C from actual measurements and less than 1 C in 84% of the time. It is concluded that the establishment of such simple temperature models would be very useful in a wide range of ecological studies in streams. (Author's abstract)
W88-01830

ARE SNAILS IMPORTANT COMPETITORS IN STREAM ECOSYSTEMS,
Utah State Univ., Logan. Dept. of Fisheries and Wildlife.
C. P. Hawkins, and J. K. Furnish.
Oikos OIKSAA, Vol. 49, No. 2, p 209-220, June 1987. 4 fig, 5 tab, 60 ref. NSF Grant No. BSR-8306892.

Descriptors: *Ecosystems, *Snails, *Streams, Benthic environment, Biomass, Invertebrates, Population density, Algae, Ecological distribution.

Juga silicula (Gould) is an omnivorous pleurocerid snail that inhabits many streams in NW USA. In some streams it comprises more than 90% of invertebrate standing crop biomass. Analysis of benthic samples from 20 stream reaches showed that densities of many invertebrate taxa were inversely correlated with snail density. Experimental reduction of snail density resulted in higher algal standing crops and higher densities of many, although not all invertebrate taxa. The taxa most strongly affected by Juga were those that: (1) overlapped most extensively with Juga in habitat use; and (2) were sedentary. Juga also affected the between habitat distribution of individuals. These effects were generally species-specific and related to habitat preferences of each species. Juga appears to be a competitive dominant in some streams and may profoundly influence both abundances of individual species and community structure. Furthermore, because individuals of Juga are not generally eaten by vertebrate predators, this snail may also affect trophic dynamics by reducing energy transfer to higher trophic levels. (Author's abstract)
W88-01831

CONTROL OF EUTROPHICATION OF LAKES AND RESERVOIRS BY MEANS OF PREDAMS. I. MODE OF OPERATION AND CALCULATION OF THE NUTRIENT ELIMINATION CAPACITY,
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
For primary bibliographic entry see Field 5G.
W88-01844

IDENTIFICATION AND DETERMINATION OF 4-(CHLOROMETHYLSULFONYL)BROMOBENZENE, A NEW HERBICIDE ADDITIVE, IN LAKE WATERS,
National Inst. for Environmental Studies, Tsukuba (Japan). Div. of Chemistry and Physics.
For primary bibliographic entry see Field 5A.
W88-01846

NUTRIENT DYNAMICS IN SMALL MESOTROPHIC FENS SURROUNDED BY CULTIVATED LAND, II.: N AND P ACCUMULATION IN PLANT BIOMASS IN RELATION TO THE RELEASE OF INORGANIC N AND P IN THE PEAT SOIL,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Plant Ecology.
J. T. A. Verhoeven, and H. H. M. Arts.
Oecologia OECOBX, Vol. 72, No. 4, p 557-561, July 1987. 6 tab, 22 ref.

Descriptors: *Nutrients, *Wetlands, *Fens, *Nitrogen, *Phosphorus, *Peat bogs, Soil water, Nutrient cycling, Inorganic compounds, Mineralization, Groundwater movement, Solute transport, Biomass, Netherlands.

Release of inorganic N and P in the organic soils of three small quaking fens in The Netherlands was studied by means of in situ incubation of the peat soil in plastic bottles. One of the fens had higher biomass production and lower species richness than the other two. The former fen is located in an area with downward groundwater percolation, whereas the latter fens are situated in an area of upward seepage of groundwater rich in calcium and bicarbonate. Mineralization of N proved to be slow in the low-productive fens, and 6 times faster in the highly productive fen. In the latter fen the amount of N mineralized during a certain period exceeded by far the amount accumulated in that period in the above-ground parts of the vegetation. The release of inorganic P was extremely slow in the two low-productive fens and rapid in the highly productive fen. The release rates were not related to the total P content of the soils. The slow P release in the low-productive fens may be due to the continuous inflow of groundwater rich in Ca, Al and Fe compounds. It is concluded that the soil is a potentially large source of inorganic N and P in a quaking fen. The importance of the soil versus other N and P sources is greater in nutrient-rich fens. (Author's abstract)
W88-01848

WEIGHT-DENSITY RELATIONSHIPS IN SUBMERGED MACROPHYTES: THE IMPORTANCE OF LIGHT AND PLANT GEOMETRY,
McGill Univ., Montreal (Quebec). Dept. of Biology.
C. M. Duarte, and J. Kalff.
Oecologia OECOBX, Vol. 72, No. 4, p 612-617, July 1987. 3 fig, 3 tab, 53 ref.

Descriptors: *Aquatic plants, *Macrophytes, *Light intensity, Plant growth, Quebec, Lakes, Biomass, Ecological distribution.

Crowded stands of submerged plants in Quebec lakes have a weight-density with a shallower, but not significantly different, slope and an intercept 10 fold lower than those for terrestrial stands. The examination of a larger data set including both freshwater and submerged macrophytes supported these differences. This data set suggested that those differences, as well as those among submerged stands, are largely attributable to the light levels incident upon the stand. The differences in weight-density relationships between submerged and terrestrial stands were paralleled by a smaller biomass per unit volume outgrown of the submerged plants, as predicted from the dimensional examination of the weight-density relationship. The variations in biomass per unit volume associated to differences in the species growth form explained deviations about the weight-density relationship of stands growing under relatively similar light conditions. (Author's abstract)
W88-01849

LONGITUDINAL PATTERNS OF ECOSYSTEM PROCESSES AND COMMUNITY STRUCTURE IN A SUBARCTIC RIVER CONTINUUM,
Woods Hole Oceanographic Institution, MA.
R. J. Naiman, J. M. Melillo, M. A. Lock, T. E. Ford, and S. R. Reice.
Ecology ECOLAR, Vol. 68, No. 5, p 1139-1156, October 1987. 7 fig, 7 tab, 48 ref.

Descriptors: *Ecosystems, *Subarctic regions, *Rivers, Organic carbon, Quebec, Fluvial transport, Geochemistry, Moisie River.

Ecosystem processes and community structure in running waters of the boreal forests of Quebec, Canada, are strongly influenced by climate and channel geomorphology. Here an overview of a project examining longitudinal trends as small streams gradually coalesce into large rivers is presented, summarizing the results in a series of budgets and predictive equations describing changes in organic carbon dynamics and community structure. There were significant trends with stream order for 70% of the 73 components, processes, and ratios examined. Of 46 independent components examined, 63% showed a significant trend with stream order. As stream size increased from 1st to 9th order there was a decrease in total carbon inputs (i.e., precipitation, throughfall, primary production, and allochthonous materials) followed by a gradual increase due to greater primary production in streams >6th order. The standing stock of carbon decreased exponentially downstream, and total carbon outputs (i.e., respiration, leaching, methane evasion, and insect emergence) increased slightly downstream. The data, when placed in a watershed perspective, showed that total carbon inputs were evenly distributed by stream order throughout the 19,871-sq km Moisie River drainage network. Most carbon was stored in the small 1st to 3rd order streams, whereas the majority of organic carbon was metabolized in the 7th to 9th order rivers. Fluvial transport of organic carbon to the Gulf of St. Lawrence was nearly three times that of the measured total annual input, suggesting that inputs of dissolved organic carbon in groundwater were more important than previously expected. Ecosystem-level measurements of carbon retention and utilization also showed significant trends with stream order. The spiraling length for carbon increased exponentially from 8-15 km in small streams to 426 km in the 9th order river. It is concluded that these subarctic lotic ecosystems have numerous strong relationships with stream order and that the dynamics can be described by a relatively small set of predictive equations. (Author's abstract)
W88-01871

NITROGEN DYNAMICS DURING SUCCESSION IN A DESERT STREAM,
Arizona State Univ., Tempe. Dept. of Zoology.
N. B. Grimm.
Ecology ECOLAR, Vol. 68, No. 5, p 1157-1170, October 1987. 7 fig, 6 tab, 67 ref. NSF Grant Nos. DEB 80-04145 and BSR 84-06891.

Descriptors: *Nitrogen, *Deserts, *Streams, *Sycamore Creek, *Arizona, *Ecosystems, Nutrients, Model studies, Biomass, Arid regions.

Nitrogen dynamics of Sycamore Creek, Arizona, a lowland Sonoran Desert stream, are described by seven diel input-output budgets at different stages of postflood succession. Hydrologic inputs and outputs of nitrogen and N storage in periphyton, macroinvertebrates, and fish were measured over 24-h periods. Total nitrogen storage in this desert stream (3-9 g/sq m) was lower than that in forest streams of Oregon (12 g/sq m) and Quebec (22 g/sq m). While >99% of nitrogen in the forest systems is in allochthonous detritus, benthic algae and autochthonous detritus comprised approximately 90% of the total nitrogen pool in the desert stream. Up to 14% of nitrogen was in consumer organisms. Inputs of nitrogen to the stream ecosystem were dominated by dissolved nitrogen, of which 19-60% was inorganic, primarily nitrate. Particulate nitrogen in transport (4-15% of total input) was mostly autochthonous. Inputs of nitrogen exceeded outputs on most study dates. Rates of ecosystem nitrogen retention were as high as 400 mg/sq m/d and outputs exceeded inputs on only one study date. Retention was primarily of inorganic nitrogen and was presumed due to autotrophic assimilation. Nitrogen retention data from the seven budgets were used to evaluate a model that patterns of nitrogen retention during succession reflect patterns of net ecosystem production and biomass accumulation. Biomass and stored nitrogen increased asymptotically during a postflood successional sequence at a single site; nitrogen retention during this period accounted for increases in storage. Nitrogen retention among the seven study dates exhibited the predicted successional patterns of increases from early to middle successional stages, followed by late stage declines. (Author's abstract)
W88-01872

EUTROPHICATION MODEL OF THE VENICE LAGOON: STATISTICAL TREATMENT OF 'IN SITU' MEASUREMENTS OF PHYTOPLANKTON GROWTH PARAMETERS,
Venice Univ. (Italy). Dept. of Spectroscopy, Electrochemistry and Physical Chemistry.
For primary bibliographic entry see Field 5C.
W88-01878

TOTAL ALKALINITY OF SURFACE WATERS: A MAP OF THE WESTERN REGION.
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 7C.
W88-01884

MAXIMUM DEPTH OF RESERVOIR DRAWDOWN,
For primary bibliographic entry see Field 8C.
W88-01900

ESTIMATES OF ACIDIFICATION OF LAKES IN THE MT. ZIRKEL WILDERNESS AREA, COLORADO,
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 5A.
W88-01915

ALPHA, BETA, GAMMA OF EVAPORATION FROM SALINE WATER BODIES,
Woodward-Clyde Consultants, Walnut Creek, CA.
For primary bibliographic entry see Field 2D.
W88-01917

ECOSYSTEM MODEL OF PHOSPHORUS CYCLING IN A WARM MONOMICTIC, HYPERTROPHIC IMPOUNDMENT,
National Inst. for Water Research, Pretoria (South Africa).
K. L. Cochrane, P. J. Ashton, A. C. Jarvis, A. J. Twinch, and T. Zohary.
Ecological Modelling ECMODT, Vol. 37, No. 3/4, p 207-233, July 1987. 7 fig, 9 tab, 28 ref.

Descriptors: *Nutrient cycling, *Phosphorus, *Ecosystems, *Model studies, *Lakes, *Limnology, Lake morphology, Hypertrophic impoundments, Eutrophication, Phytoplankton, Zooplankton, Hypolimnion, Epilimnion.

A mechanistic model of phosphorus cycling in a hypertrophic, warm monomictic impoundment (Hartbeespoort Dam, South Africa) was designed to quantify phosphorus cycling in the lake and to permit evaluation of various management options aimed at alleviating the problems of eutrophication. Input data consist of phosphorus loads and hydrological and meteorological data. The exchange of phosphorus between 13 abiotic and biotic compartments is computed daily using rates measured in the lake wherever possible. The model simulated phosphorus cycling in and between the epilimnion and hypolimnion. Phytoplankton growth in the model is related to light and nutrient availability but at prevailing high nutrient concentrations nutrients are not limited. Zooplankton growth is controlled by grazing rate which is related to food availability and zooplankton biomass. Fish are not food-limited but are regulated by juvenile mortality and fishing mortality. The evaluation of the relationship between predicted annual means and observed data showed phosphorus and zooplankton predictions to have less than 20% error while phytoplankton showed greater error but was still simulated with acceptable accuracy. (Author's abstract)
W88-01978

ENTROPY BALANCE IN LAKE BIWA,
Osaka Univ. (Japan). Dept. of Physics.
I. Aoki.
Ecological Modelling ECMODT, Vol. 37, No. 3/4, p 235-248, July 1987. 2 fig, 10 ref, 4 append.

Descriptors: *Limnology, *Lake evaporation, *Entropy balance, *Lake Biwa, Energy, Radiation, Energy loss, Energy equations.

From the thermodynamic point of view, entropy is a concept of equal importance to energy. Entropy as well as energy in the northern basin of Lake Biwa, the largest lake in Japan, are discussed here. First, the annual energy budget in the northern basin of Lake Biwa is summarized. Then the annual entropy fluxes associated with direct, diffuse and reflected shortwave radiation in the Lake are calculated. Also, the annual entropy fluxes associated with terrestrial longwave radiation and with latent and sensible heat flows are given. From these entropy fluxes, the annual entropy production in the lake is given as 11.5 MG/sq m/yr/K on the assumption of stationarity of the total entropy in the lake. Entropy flows from the lake surface to the atmosphere and to outer space by infrared radiation, evaporation of water and heat conduction in the ratios 1.0:1.1:0.4. The ratio of the entropy of incoming shortwave radiation to the net outgoing entropy is 1.0:5.0. (Author's abstract)
W88-01979

LIGHT AND NUTRIENTS IN THE CONTROL OF AQUATIC PLANT COMMUNITY STRUCTURE. I. IN SITU EXPERIMENTS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
P. A. Chambers, and J. Kalff.
Journal of Ecology JECOAB, Vol. 75, No. 3, p 611-619, September 1987. 5 fig, 1 tab, 18 ref.

Descriptors: *Light, *Limnology, *Lakes, *Aquatic plants, *Nutrients, Ecosystems, Biomass, Radiation, Species diversity, Vermont, Potamogeton praelongus, Vallisneria americana, Potamogeton robbinsii, Plant growth, Sediments.

Maximum summer biomass and morphology of Potamogeton praelongus, Vallisneria americana and Potamogeton robbinsii were influenced by both sediment composition and irradiance when plants were grown in Lake Memphremagog, Quebec-Vermont, at depths of 1.5, 2 and 3 m, in buckets containing mixtures of fertile sediment (100%, 30%, 10%) and sand (0%, 70%, 90% respectively). While all species attained maximum biomass and morphological diversity at 1.5 m in 100% fertile sediment and minimum biomass in the least fertile sediment, the effects of sediment composition and irradiance on growth differed between the species. Biomass of the erect P. praelongus was primarily determined by sediment composition whereas the biomass of the bottom-dwelling P. robbinsii was largely determined by irradiance; the intermediate, rosette-form, V. americana, showed an intermediate response. Sediment and irradiance effects on these species are consistent with their growth form, suggested that the natural distribution of submerged aquatic plant species is related to plant growth form. (See also W88-01981) (Author's abstract)
W88-01980

GROUNDWATER FLOW IN A BOG-FEN COMPLEX, LOST RIVER PEATLAND, NORTHERN MINNESOTA,
Syracuse Univ., NY. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W88-01982

DISTRIBUTION AND IN SITU SURVIVAL AND ACTIVITY OF KLEBSIELLA PNEUMONIAE AND ESCHERICHIA COLI IN A TROPICAL RAIN FOREST WATERSHED,
Puerto Rico Univ., Rio Piedras. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W88-01986

EPIZOOIC CILIATES (VORTICELLA SP.) COMPETE FOR FOOD WITH THEIR HOST DAPHNIA LONGISPINA IN A SMALL POLYHUMIC LAKE,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
P. Kankaala, and P. Eloranta.
Oecologia OECOBX, Vol. 73, No. 2, p 203-206, September 1987. 3 fig, 2 tab, 11 ref.

Descriptors: *Ciliates, *Food chains, *Daphnia longispina, *Limnology, *Lakes, Vorticella, Plankton, Food habits, Ecosystems, Lake morphology.

Clearance rates of epizooic ciliates (Vorticella sp.) were measured together with their host, a planktonic cladoceran Daphnia longispina by using fluorescent latex beads as tracers of food. Vorticellans and their host graze on food of same size range (nanoplanktonic algae and bacteria). Individual clearance rates of Vorticella averaged 6.9 and 7.0 microL/ind/hr and those of Daphnia 463 and 708 microL/ind/hr for beads with diameter 2.00 and 3.92 micrometers. On the average, epizooic vorticellans together on the carapace of Daphnia cleared particles with rates representing 25-33% of that the host cleared, the maximum rates being 50-80%. In a steeply stratified polyhumic lake vorticellans take advantage of following Daphnia to food patches and they can severely compete for food with their host. (Author's abstract)
W88-01987

PHOTOSYNTHETIC KINETICS DETERMINE THE OUTCOME OF COMPETITION FOR DISSOLVED INORGANIC CARBON BY FRESHWATER MICROALGAE: IMPLICATIONS FOR ACIDIFIED LAKES,
Queen's Univ., Kingston (Ontario). Dept. of Biology.
T. G. Williams, and D. H. Turpin.
Oecologia OECOBX, Vol. 73, No. 2, p 307-311, September 1987. 3 fig, 1 tab, 27 ref.

Descriptors: *Photosynthesis, Kinetics, *Acid rain, *Organic carbon, *Microalgae, *Acid rain, *Acidic water, *Lakes, *Algae, *Limnology, Lake morphology, Environmental effects, Hydrogen ion concentration, Acidification.

Photosynthetic kinetics with respect to dissolved inorganic carbon (DIC) were used to predict the outcome of competition for DIC between the green algae Selenastrum minutum and the cyanobacterium Synechococcus leopoliensis at pH 6.2, 7.5, and 10. Based on measured values of the maximum rate of photosynthesis, the half-saturation value of photosynthesis with respect to DIC (K sub 1/2 to the DIC), and the DIC compensation point, it was predicted that S. leopoliensis would lower the steady-state DIC concentration below the DIC compensation point of S. minutum. This should result in competitive displacement of the green alga at a rate equivalent to the chemostat dilution rate. This prediction was validated by carrying out competition experiments over the range of pH. These results suggest that the low levels of DIC in air-equilibrated acidified lakes may be an important rate-limiting resource and hence affect phytoplankton community structure. Furthermore, the low levels of DIC in these systems may be below the DIC compensation point for some species, thereby precluding their growth at acid pH solely as a function of DIC limitation. The potential importance of DIC in shaping phytoplankton community structure in acidified systems is discussed. (Author's abstract)
W88-01988

LAKE PERCHED ON PISCINE PERIL,
Coventry (Lanchester) Polytechnic (England).
For primary bibliographic entry see Field 2G.
W88-01989

RELATIONSHIP BETWEEN WINTER LAKE COVER, RADIATION RECEIPTS AND THE OXYGEN DEFICIT IN TEMPERATE LAKES,
National Hydrology Research Inst., Saskatoon (Saskatchewan).
T. D. Prowse, and R. L. Stephenson.
Atmosphere-Ocean ATOCDA, Vol. 24, No. 4, p 386-403, December 1986. 5 fig, 49 ref.

Descriptors: *Model studies, *Snowfall, *Temperate lakes, *Lake ice, *Seasonal variation, *Limnology, Solar radiation, Oxygen, Lakes.

The composition, timing and duration of winter lake cover are shown to produce significant spatial and temporal variations in the radiation received at the surface of the water column, and are linked to the timing and rate of oxygen depletion of a temperate lake. In particular, the first snowfall to accumulate on the ice cover reduces radiation input to nearly zero and coincides with the initiation of the linear phase of oxygen depletion. Ablation of the snow cover in spring results increased radiation receipts and oxygen levels. A simple model shows that the conversion of snow to white ice, which normally occurs during the midwinter period, increases radiation receipts and oxygen levels. Manipulation of the cover by artificially induced slushing is suggested as a management technique in the control of winter oxygen deficits. (Author's abstract)
W88-02005

EFFECT OF CARBOHYDRATE IN THE SEDIMENT ON THE MUSTY ODOR PRODUCTION BY ACTINOMYCETES,
National Inst. for Environmental Studies, Yatabe (Japan).
N. Sugiura, O. Yagi, and R. Sudo.
Environmental Technology Letters ETLEDB, Vol. 8, No. 2, p 95-103, February 1987. 4 fig, 4 tab, 25 ref.

Descriptors: *Limnology, *Carbohydrates, *Sediments, *Lakes, *Odors, *Lake Kasumigaura, *Actinomycetes, Microorganisms, Prediction.

The microorganisms producing musty odors, the compounds responsible for musty odors, and several environmental factors relating to musty odors in Lake Kasumigaura, Japan, were determined. When musty odor occurred at the Tsuchiurairi site in October 1984, 2-methylisoborneol was detected in sediments with high actinomycete numbers. Moreover, a remarkable increase of carbohydrate was

found in the sediment. The musty odor potential of sediments with actinomycetes was very high when odor occurred. Study of actinomycete numbers and carbohydrate content in the sediment was effective for prognostication of musty odors in Lake Kasumigaura. (Author's abstract)
W88-02013

VARIATION IN APPARENT TRACE METAL COMPLEXING CAPACITY OF NATURAL WATERS WITH PLATING POTENTIAL USING ANODIC STRIPPING VOLTAMMETRY,
Western Australia School of Mines, Kalgoorlie.
J. H. Kyle.
Environmental Technology Letters ETLEDB, Vol. 8, No. 4, p 181-188, April 1987. 3 fig, 2 tab, 11 ref.

Descriptors: *Voltammetry, *Water chemistry, *Metal complexes, *Limnology, *Lakes, Copper, Model studies.

The measurement of the copper complexing capacity of natural waters by anodic stripping voltammetry (ASV) has been shown to be dependent on the plating potential used to measure the concentration of electroactive copper in solution. Results are presented for the complexing capacities and conditional stability constants of 3 Papua New Guinean lake waters at pH 6.0 measured at the plating potentials -0.3, -0.6, -0.9 and -1.2v versus SCE. The results are rationalised using both a single ligand model and a two ligand model. (Author's abstract)
W88-02015

MEASUREMENT OF CADMIUM ADSORPTION ON SEDIMENTS OF LAKE COMABBIO - NORTH ITALY (MESURES D'ADSORPTION DU CADMIUM SUR LES SEDIMENTS DU LAC DE COMABBIO - ITALIE DU NORD),
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 5B.
W88-02016

EFFECTS OF ATRAZINE ON DISSOLVED OXYGEN AND NITRATE CONCENTRATIONS IN AQUATIC SYSTEMS,
State Univ. of New York Coll. at Plattsburgh. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W88-02022

MICROBIAL POLLUTION OF THE BLUE AND WHITE NILES AT KHARTOUM,
Khartoum Univ. (Sudan). Faculty of Agriculture.
For primary bibliographic entry see Field 5A.
W88-02023

TRACING OF XENOBIOTIC CONTAMINATION IN WATER WITH THE AID OF FISH BILE METABOLITES: A FIELD STUDY WITH CAGED RAINBOW TROUT (SALMO GAIRDNERI),
Joensuu Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W88-02031

EFFECTS OF 2,4-D TREATMENT ON NATURAL BENTHIC MACROINVERTEBRATE COMMUNITIES IN REPLICATE ARTIFICIAL PONDS,
Guelph Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W88-02036

IMPACT OF LITTER AND ANNUAL PLANTS ON RECRUITMENT FROM THE SEED BANK OF A LACUSTRINE WETLAND,
Iowa State Univ., Ames. Dept. of Botany.
A. G. van der Valk.
Aquatic Botany AQBODS, Vol. 24, No. 1, p 13-26, March 1986. 7 fig, 44 ref.

Descriptors: *Litter, *Marshes, *Vegetation establishment, *Seeds, *Aquatic plants, *Wetlands, Organic matter, Drawdown, Algae, Density, Population density, Cattails, Grasses, Ecology, Mud flats, Seedlings.

Field studies were conducted in 1984 in an experimental marsh complex in Manitoba, involving removal of fallen, emergent, filamentous algae and mixed (algal and emergent). Removal of litter significantly increased the number of species and the number of individuals of a species recruited from the seed bank. During 1984, the number of species and number of individuals in the removal treatment at emergent- and mixed-litter sites was again significantly higher than in the controls, but there was no longer a difference at algal litter sites. Addition of a mat of Typha litter at sites free of litter reduced seedling recruitment from the seed bank almost completely in 1983 and 1984. Removal of standing litter from sites at higher elevations that were invaded by Typha or Phragmites during a high-water period immediately prior to 1983 also increased the number of species and the number of individuals of a species compared with the controls in 1983. Removal of seedlings of the mudflat annual Atriplex patula increased the number of grass shoots significantly in 1983 and 1984. Grasses in the seedling removal treatment were also taller and flowered inn 1983, the first year of a drawdown. (Author's abstract)
W88-02077

INFLUENCE OF DOMESTIC SEWAGE ON GROWTH AND NITROGEN FIXATION OF AZOLLA PINNATA R. BR.,
Burdwan Univ. (India). Dept. of Botany.
For primary bibliographic entry see Field 5E.
W88-02078

BIOMASS AND SPECIES RICHNESS OF AQUATIC MACROPHYTES IN FOUR MAINE (U.S.A.) LAKES OF DIFFERENT ACIDITY,
Maine Univ. at Orono. Dept. of Wildlife.
For primary bibliographic entry see Field 5C.
W88-02079

GERMAN TECHNICAL STANDARD FOR THE ASSESSMENT OF LAKE WATER QUALITY AND ITS APPLICATION TO HARTBEESPOORT DAM (SOUTH AFRICA),
National Inst. for Water Research, Pretoria (South Africa).
J. A. Thornton.
Water SA, Vol. 13, No. 2, p 87-93, April 1987. 4 tab, 30 ref.

Descriptors: *Water quality standards, *Lakes, *Data interpretation, Water use, Tobacco, Chlorides, Water quality, Dams.

The lack of a convenient, integrative definition of the term 'water quality' can create confusion and misunderstanding between disciplines, the term being variously interpreted as meaning bacterial/viral status, salinity status, turbidity status, or nutrient status, for example. The GDR (German Democratic Republic) Technical Standard for the assessment of lake water quality uses a simple quantitative ranking technique to overcome the confusion surrounding the term water quality by integrating hydrographical, trophic state and hygiene-related criteria into a single use-class measurement that can be used to determine the suitable uses for a water body. Application of the assessment technique to hypertrophic Hartbeespoort Dam demonstrates the usefulness of this method under southern African conditions. It is equally applicable to north temperate as well as south (sub-) tropical lakes, although minor adjustments may be needed to fulfill local requirements more closely in the case of specific lakes. (Airone-PTT)
W88-02091

NONLINEAR PROGRAMMING METHODS IN RESERVOIR SYSTEM MANAGEMENT,
Tennessee Univ., Knoxville.
R. E. Rosenthal, M. Hanscom, and R. S. Dembo.
Available from the National Technical Institute Service Springfield, VA 22161, as PB87 218221/AS, price codes: A04 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center, Knoxville, Pub. No. R01-2550-007-83. Final Technical Completion Report, April 1983. 57 p, 32 ref. Department of the Interior Contract No. 14-34-0001-1265, Project No. B-054-TENN(1).

Descriptors: *Reservoir management, *Systems analysis, *Nonlinear programming, *Computer programs, *Optimization, Mathematical studies, Mathematical analysis, Newton algorithms, Kuhn-Tucker Theory, Algorithms, Mathematical equations.

In a recent state-of-the-art review of optimization methods for managing reservoir systems, it was concluded that nonlinear programming methods had less viability than other, more commonly used alternatives. This report considers the status of existing nonlinear programming algorithms, and reaches a more favorable conclusion. Several existing techniques not included in the earlier survey are discussed in detail; these are: (1) the Kuhn-Tucker Theory, (2) reduced gradient methods (with conjugate and superbasic sets), and (3) global selection strategies for superbasic sets. A new approach based on the concept of truncated Newton algorithms is also presented. (Author's abstract)
W88-02273

VERTICAL, HORIZONTAL, AND DIEL DISTRIBUTION OF INVERTEBRATE DRIFT IN THE LOWER MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. C. Beckett, and R. L. Kasul.
Available from the National Technical Information Service, Springfield, Virginia. 22161. Technical Report E-87-5, March 1987. Final Report. 36 p, 3 fig, 4 tab, 22 ref.

Descriptors: *Diel distribution, *Mississippi River, *Invertebrates, *Vertical distribution, *Horizontal distribution, Population density, Chaoborus, Larvae, Midges, Hydra, Hydropsyche, Hexagenia, Species diversity.

Lower Mississippi River macroinvertebrates drift densities and composition were determined at 3-hr intervals over 24-hr periods in mid-May and early June 1982. Samples were taken at the surface, middepth, and near the bottom at a nearshore sampling station and at the surface and middepth at a sampling station near the navigation channel. The overall mean drift density equaled 35.0 invertebrates/100 cu m of water. Overall, Chaoborus larvae were the most common invertebrates collected, followed, respectively, by chironomid pupae, Hydra sp., Hydropsyche orris, and Hexagenia sp. The abundance of various taxa in the Lower Mississippi River's drift seem to change markedly on a site-to-site basis, as a function of the physical characteristics of the river and its substrates in a certain area. This site-to-site heterogeneity, coupled with the lack of lateral homogeneity and the definite diel periodicity exhibited by some taxa, provides evidence that, even in an immense river such as the Mississippi, may of the organisms drift as they do in small streams, traveling relatively short distances with total movement rather saltatory. Since the total number of drifting invertebrates in the system is a product of drift densities times river discharge, and the Lower Mississippi River has the largest discharge of any North American river, a very high number of macroinvertebrates drift down the river over even short time intervals. Over 24-hr periods in May and in June, approximately 405 million and 479 million macroinvertebrates, respectively, drifted past a transverse plane across the river through the sampling points. These large numbers of drifting invertebrates serve as a potential food source for fishes, as well as being potential colonizers of the river's substrates. (Lantz-PTT)
W88-02278

IMPORTANCE OF WHITING AS A COMPONENT OF RAW WATER TURBIDITY,
Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 5F.
W88-02320

TRACE METAL DISTRIBUTION IN DROWNED PLANTS, SHASTA RESERVOIR, CALIFORNIA,
Bureau of Reclamation, Sacramento, CA. Mid-Pacific Regional Office.
For primary bibliographic entry see Field 5B.
W88-02333

ISOLATION AS A RESTORATION STRATEGY FOR NUTRIENT REDUCTION IN A SMALL HYPEREUTROPHIC LAKE,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W88-02336

CONCEPT AND DESIGN OF A SUBSTRATA CONTAINER FOR SAMPLING PERIPHYTON,
Victoria Univ. (British Columbia). Dept. of Biology.
For primary bibliographic entry see Field 7B.
W88-02337

COPPER AS AN ALGICIDE IN A TROPICAL RESERVOIR,
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Botany.
For primary bibliographic entry see Field 5G.
W88-02347

ELECTROTHERMAL ATOMIC-ABSORPTION SPECTROMETRIC ANALYSIS OF LAKE WATERS FOR MN, FE, PB, AND CD,
Department of Energy, New York. Environmental Measurements Lab.
For primary bibliographic entry see Field 5A.
W88-02359

ACIDOPHILIC HETEROTROPHIC BACTERIA ISOLATED FROM ACIDIC MINE DRAINAGE, SEWAGE, AND SOILS,
Mimasaka Women's Junior Coll., Okayama (Japan).
For primary bibliographic entry see Field 5B.
W88-02367

STOCHASTIC DYNAMIC PROGRAMMING BASED APPROACH TO THE OPERATION OF A MULTI-RESERVOIR SYSTEM,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
F.-K. Tai, and I. C. Goulter.
Water Resources Bulletin WARBAQ, Vol. 23, No. 3, p 371-377, June 1987. 3 fig, 3 tab, 12 ref.

Descriptors: *Reservoir operation, *Operating policies, *Stochastic process, *Reservoirs, *Model studies, *Inflow, *Streamflow, Water storage, Flow, Hydroelectric power.

An heuristic iterative technique based upon stochastic dynamic programming is presented for the analysis of the operation of a three reservoir 'Y' shaped hydroelectric system. The technique is initiated using historical inflow data for the downstream reservoir. At each iteration the optimal policies for the downstream hydroelectric generating unit are used to provide relative weightings or targets for operation of upstream reservoirs. New input inflows to the downstream reservoir are then obtained by running the historical streamflow record through the optimal policies for the upstream reservoirs. These flows are then used to develop a new operating policy for the downstream reservoir and hence new targets for the upstream reservoirs. The process is continued until the operating policies for each reservoir provide the same overall system benefit for two successive iterations. Results obtained from the procedure are compared to the results obtained by historical operation of the system. The procedure is shown to develop operating policies which give benefits which are as close to the historical benefits as can be expected given the choice of the number of storage state variables. (Author's abstract)
W88-02376

PREDICTING THE SUMMER PEAK BIOMASS OF FOUR SPECIES OF BLUE-GREEN ALGAE (CYANOPHYTA/CYANOBACTERIA) IN SWEDISH LAKES,
North Carolina Univ. at Chapel Hill. Dept. of Biology.
V. H. Smith, E. Willen, and B. Karlsson.
Water Resources Bulletin WARBAQ, Vol. 23, No. 3, p 397-402, June 1987. 1 fig, 2 tab, 36 ref.

Descriptors: *Prediction, *Biomass, *Lakes, *Limnology, *Model studies, *Algae, Nutrients, Phosphorus, Regression analysis.

Stepwise multiple regression analysis was used to develop models predicting the summer peak biomass of Aphanizomenon flos-aquae, Anabaena flos-aquae, Oscillatoria agardhii, and Microcystis aeruginosa in four Swedish lakes. These analyses suggest that while epilimnetic total phosphorus concentration is the principal predictor of their peak biomass, other factors such as station mean depth, water temperature, total nitrogen, and total CO_2 concentration are also important. (Author's abstract)
W88-02379

GENERALIZED WATERSHED LOADING FUNCTIONS FOR STREAM FLOW NUTRIENTS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W88-02386

RELATIONSHIP BETWEEN SUMMER-SEASON RAINFALL EVENTS AND LAKE-SURFACE AREA,
Nebraska Univ.-Lincoln. Conservation and Survey Div.
For primary bibliographic entry see Field 2A.
W88-02389

OPTIMAL DAILY OPERATION OF SURFACE-WATER SYSTEMS,
Lower Colorado River Authority, Austin, TX. Water Policy and Programs Div.
For primary bibliographic entry see Field 6D.
W88-02412

RELIABILITY INDICES FOR WATER SUPPLY SYSTEMS,
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W88-02420

ANIMAL DECISION MAKING AND ITS ECOLOGICAL CONSEQUENCES: THE FUTURE OF AQUATIC ECOLOGY AND BEHAVIOR,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
L. M. Dill.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 4, p 803-811, April 1987. 3 fig, 2 tab, 82 ref. NSERC (Canada) Grant A6869.

Descriptors: *Aquatic ecology, *Research priorities, *Decision making, *Behavioral ecology, *Data interpretation, *Animal behavior, Predation, Energy, Game theory, Guppies.

It is virtually impossible to predict the next 25 years of research in aquatic ecology and behavior with any accuracy. However, by identifying those areas that are the current frontiers of the discipline it is possible to guess at the most likely research developments over the next decade. The research program most likely to be productive in the near future is that of behavioral ecology, which studies, among other things, animal decision making in an ecological context. Animals must make decisions under conflicting objectives, e.g., to simultaneously maximize net energy intake while minimizing risk of predation. New data on guppies (Poecilia reticulata) are presented and the recent literature is reviewed to support the notion that animals in such situations behave so as to maximize fitness. Habitat choices, ontogenetic habitat shifts, and the phenomena of vertical migration and downstream drift are beginning to be considered in this general evolutionary framework, with novel results, and this trend will undoubtedly continue. Extension of the logic of trade-offs to the community level leads to a number of new insights about the processes that shape community structure, and affirms the need for aquatic ecologists of the future to have a thorough understanding of animal behavior, and a working knowledge of such tools of evolutionary ecology as optimality reasoning and game theory. (Author's abstract)
W88-02423

HABITAT USE OF THE CENTRAL MUDMINNOW (UMBRA LIMI) AND YELLOW PERCH (PERCA FLAVESCENS) IN UMBRA-PERCA ASSEMBLAGES: THE ROLES OF COMPETITION, PREDATION, AND THE ABIOTIC ENVIRONMENT,
Alberta Univ., Edmonton. Dept. of Zoology.
W. M. Tonn, and C. A. Paszkowski.
Canadian Journal of Zoology CJZOAG, Vol. 65, No. 4, p 862-870, April 1987. 5 fig, 2 tab, 50 ref. NSERC (Canada) Operating Grant A2363.

Descriptors: *Habitat use, *Competing use, *Limnology, *Lakes, *Minnows, Perch, *Predation, Fish behavior, Fish, Seasonal variation, Population dynamics.

Spatial distributions and diel activity patterns of three fish populations (co-occurring central mudminnows and yellow perch, and a mudminnow population in a single-species asemblage) throughout the year in two small, northern Wisconsin dystrophic lakes were compared. In winter, all three populations were more active offshore and during the day. During spring and summer through fall all were concentrated inshore, near the bottom, and were more active around dawn and dusk. Winter distributions appeared to be responses to abiotic conditions (ice cover and low oxygen availability); overall patterns during open-water periods appeared to be linked to prey availability (e.g., chironomid emergences). Although the three populations were generally similar, some aspects of habitat use differed between species, between lakes, or between dominant and subdominant populations, with the direction of differences varying seasonally. The yellow perch population was recovering from a size-selective winterkill and between spring and summer underwent an ontogenetic niche shift, first being competitors with mudminnows, then becoming predators on mudminnows. Mudminnows did not alter their vertical or diel activity patterns in the presence of these predatory perch. They did become more concentrated inshore in summer through fall, near structural refuge provided by the bog mat, and, unlike the other two populations, failed to shift their activities offshore at twilight. Our study suggested that a simple habitat in the study lakes contributed both to overall similarities in habitat use and strong interactions between co-occurring populations. However, the ecological flexibility demonstrated by mudminnows may prevent their total exclusion from lakes inhabited by perch and allow them to respond to changing biotic environment. (Author's abstract)
W88-02425

VARIATIONS IN THE 87SR/86SR RATIO IN LAKE WATERS FROM CENTRAL SWEDEN,
Stockholm Univ. (Sweden). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W88-02439

VARIATIONS OF 87SR/86SR IN WATER FROM STREAMS DISCHARGING IN THE BOTHNIAN BAY, BALTIC SEA,
Royal Inst. of Tech., Stockholm (Sweden). Institutionen foer Kulturteknik.
For primary bibliographic entry see Field 2K.
W88-02440

AEROMONAS HYDROPHILA DENSITIES IN THERMALLY-ALTERED RESERVOIR WATER AND SEDIMENTS,
Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
For primary bibliographic entry see Field 5C.
W88-02461

CHEMICAL EFFECTS OF SPRING AND SUMMER ALUM ADDITIONS TO A SMALL, NORTHWESTERN ONTARIO LAKE,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5G.
W88-02462

BIOGENIC HYDROGEN SULFIDE EMISSIONS FROM SELECTED FLORIDA WETLANDS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W88-02463

EFFECT OF SODIUM CHLORIDE AND CALCIUM CHLORIDE ON NITRITE INDUCED METHEMOGLOBINEMIA IN CLARIAS LAZERA,
Alexandria Univ. (Egypt). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W88-02466

IMPACT OF A CHLOR-ALKALI PLANT ON ONONDAGA LAKE AND ADJOINING SYSTEMS,
Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 5C.
W88-02467

BIOMASS AND COMPOSITIONAL CHANGES IN THE PERIPHYTIC COMMUNITY OF AN ARTIFICIAL STREAM IN RESPONSE TO LOWERED PH,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W88-02468

ROLE OF ALUMINIUM CONTAMINATION IN DETERMINING PHYTOPLANKTON AND ZOOPLANKTON RESPONSES TO ACIDIFICATION,
West Virginia Univ., Morgantown. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W88-02471

PROFUNDAL MACROBENTHOS STRUCTURE AS A MEASURE OF LONG-TERM ENVIRONMENTAL STRESS IN A POLLUTED LAKE,
Rome Univ. (Italy). Dept. of Animal and Human Biology.
For primary bibliographic entry see Field 5C.
W88-02474

PH PROFILES FROM DIATOM STRATIGRAPHIES IN SEDIMENT CORES OF SELECTED LAKES OF NEW BRUNSWICK AND NOVA SCOTIA, CANADA,
Department of Fisheries and Oceans, St. Andrews (New Brunswick). Biological Station.
For primary bibliographic entry see Field 5C.
W88-02482

ACIDIFICATION OF NOVA SCOTIA LAKES: III ATMOSPHERIC DEPOSITION OF SO4 AND NO3 AND EFFECTS ON URBAN AND RURAL LAKES,
Nova Scotia Dept. of the Environment, Halifax.
For primary bibliographic entry see Field 5B.
W88-02484

LONG-TERM CHANGES IN FISH POPULATIONS OF ACID STREAMS AND LOCHS IN GALLOWAY SOUTH WEST SCOTLAND,
Freshwater Fisheries Lab., Pitlochry (Scotland).
R. Harriman, B. R. S. Morrison, L. A. Caines, P. Collen, and A. W. Watt.
Water, Air, and Soil Pollution WAPLAC, Vol. 32, No. 1/2, p 89-112, January 1987. 7 fig, 11 tab, 39 ref.

Descriptors: *Acid rain, *Acid streams, *Fish populations, *Water pollution effects, Scotland, Rainfall, Water analysis, Streams, Trout, Fish, Acidity.

During 1978-79, and again in 1984, fish populations were surveyed in 22 lochs and 27 streams in Galloway, southwest Scotland. Chemical analyses of these waters and of bulk precipitation were made over the same period. The study area includes moorland catchments and catchments with young or semi-mature coniferous forest. Trout were not caught in nets set in 5 lochs which were known to contain fish in the past. Angling records also indicated a decline in catches and increased average weight of trout in two other lochs. Evidence for the decline in fish populations suggests that this process has occurred over a period of at least 50 yr. In fishless lochs and streams the levels of acidity and Al were in the range known to be toxic to fish. Stream acidity and sulfate concentrations were significantly higher in catchments with semi-mature coniferous forests. The available evidence for long-term acidification of Galloway lochs and streams is discussed and it is concluded that acid depositions are likely to be the major cause of changes in the status of fisheries in this region. (Author's abstract)
W88-02485

HISTORY OF AIRBORNE POLYCYCLIC AROMATIC HYDROCARBONS (PAH) AND PERYLENE AS RECORDED IN DATED LAKE SEDIMENTS,
Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Elintarvikelaboratorio.
For primary bibliographic entry see Field 5B.
W88-02488

MODIFICATIONS IN PHOSPHORUS LOADING TO ONONDAGA LAKE, U.S.A., ASSOCIATED WITH ALKALI MANUFACTURING,
Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 5B.
W88-02489

RESIDUES OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN THE SPRING RIVER, MISSOURI,
Missouri Cooperative Fishery Research Unit, Columbia.
For primary bibliographic entry see Field 5B.
W88-02491

2I. Water In Plants

I. POTENTIAL EFFECTS OF PARTIAL WATER WITHDRAWALS FROM THE VERDE RIVER ON RIPARIAN VEGETATION,
Arizona State Univ., Tempe.
For primary bibliographic entry see Field 6G.
W88-01670

II. STRUCTURE OF RIPARIAN HABITATS AT SELECTED SITES ALONG THE VERDE AND EAST VERDE RIVERS OF CENTRAL ARIZONA,
Arizona State Univ., Tempe.
For primary bibliographic entry see Field 6G.
W88-01671

EFFECT OF A RAPID AND A SLOW DROUGHT CYCLE FOLLOWED BY REHYDRATION ON STOMATAL AND NON-STOMATAL COMPONENTS OF LEAF PHOTOSYNTHESIS IN PHASEOLUS VULGARIS L.,
Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Inst. de Physiologie Vegetale.
G. Cornic, I. Papgeorgiou, and G. Louason.
Journal of Plant Physiology JPPHEY, Vol. 126, No. 4/5, p 309-318, January 1987. 5 fig, 20 ref.

Descriptors: *Plant physiology, *Drought, *Rehydration, *Stomata, *Photosynthesis, Leaves, Plant tissues, Moisture deficiency, Carbon dioxide, Dehydration, Water stress, Phaseolus vulgaris L.

CO2 assimilation of leaves of kidney bean submitted to either a rapid (4 days) or a slow (8 days) drought cycle was measured. As the daily net photosynthesis showed great variations during dehydration, only the maximum daily net photosynthesis (Am) and stomatal conductance were studied. The Am decline during the first 3 days of the rapid drought cycle was due to stomatal closure, but on the last day of the rapid drought cycle and during the slow drought cycle it was due both to stomatal closure and inhibition of mesophyll activity. However, the decline in leaf photosynthesis which was observed each day along the light period during dehydration, both on plants submitted to a rapid and a slow drought cycle, was largely due to a non-stomatal inhibition. Leaf photosynthesis increased rapidly upon rehydration. It was shown that non-stomatal components of leaf photosynthesis recovered faster than the stomatal component. Photosystems I and II reaction centers were not affected by dehydration. (Author's abstract)
W88-01703

NATURAL SELECTION ON THE PLANT-WATER RELATIONS OF CLEOME SERRULATA GROWING ALONG NATURAL MOISTURE GRADIENTS,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
M. A. Farris.
Oecologia OECOBX, Vol. 72, No. 3, p 434-439, June 1987. 3 fig, 3 tab, 37 ref.

Descriptors: *Plant water potential, *Plant-water relationships, *Plant populations, *Water stress, Adaptation, Natural selection, Soil water, Plant physiology, Moisture gradient, Field tests, Seeds, Seedlings, Genetic variation, Cleome serrulata.

The extent and adaptive importance of genetically-based variation in plant water relations were investigated in two populations of the annual plant Cleome serrulata found growing along relatively short (<30 m) and mild soil moisture gradients. Field measurements of predawn plant water potentials (psi sub plant) showed that plants at the dry end of the moisture gradients had consistently lower psi sub plant in May and June of 1984; differences up to 0.9 MPa were seen along the gradients. Seeds were collected along the moisture gradients and then grown under well-watered conditions in the greenhouse. Pressure-volume curves were constructed for a total of 92 seedlings from 25 maternal plants when the seedlings were four weeks old. Considerable genetic variation in the four highly correlated water potential components was seen in both populations, suggesting relatively high heritabilities. A partial correlation analysis revealed that cell wall elasticity was higher in seedlings from maternal plants which grew in the dry portions of each site. This suggested that natural selection had acted on this character during one or more previous generations. It appears that slight variations in the physiological genotype can significantly affect overall fitness in C. serrulata. (Author's abstract)
W88-01705

DISTRIBUTION OF STREAM-EDGE VEGETATION ALONG A GRADIENT OF CURRENT VELOCITY,
Umea Univ. (Sweden). Dept. of Ecological Botany.
For primary bibliographic entry see Field 2H.
W88-01709

RELATIONS BETWEEN AQUATIC PLANT COMMUNITIES AND LAKE CHARACTERISTICS ON MACQUARIE ISLAND,
Tasmania Univ., Hobart (Australia). Dept. of Geography.
For primary bibliographic entry see Field 2H.
W88-01805

OBSERVATIONS ON WATER POTENTIAL AND DROUGHT RESISTANCE OF TREES AND SHRUBS AFTER A PERIOD OF SUMMER DROUGHT AROUND DUNEDIN, NEW ZEALAND,
Otago Univ., Dunedin (New Zealand). Dept. of Botany.
P. Bannister.
New Zealand Journal of Botany NZJBAS, Vol. 24, No. 3, p 387-392, 1986. 1 fig, 2 tab, 14 ref.

Descriptors: *Drought, *Drought resistance, *Classification, Plant water potential, Water deficit, Moisture deficiency, Shrubs, Trees.

An exceptional summer drought in Dunedin, New Zealand resulted in the wilting and damage to many plant species, and allowed observations of plant responses in April 1985. Some species (e.g., native trees such as Sophora microphylla, Hoheria angustifolia, and the introduced shrub, Ribes sanguineum) avoided drought and maintained a high water potential even though adjacent species were wilted. Other species (e.g., the native Leptospermum ericoides and the introduced broom, Cytisus scoparius) tolerated low water potentials without showing obvious signs of stress. Another group showed both wilted and non-wilted individuals with wilted plants always showing lower water potentials than adjacent non-wilted plants of the same species. Species that showed wilting were ranked in order of drought resistance by observations at sites where some species were wilted and others were not. The maximum water potentials observed in wilted shoots were highly correlated with their drought resistance. The most sensitive species (e.g., Coprosma australis and C. robusta) showing wilting at the highest water potentials and the most resistant (e.g., Teline monspessulana) at the lowest. The range of water potentials in the field was large. Some species (e.g., Nothofagus fusca, Plagianthus betulinus) showed similar minima to those recorded in the drought-free summer of 1983, while others (e.g., Podocarpus hallii, Leptospermum spp. and Brachyglottis repanda) showed much lower minimum water potentials. (McFarlane-PTT)
W88-01806

PH-RESPONSE ON LEAVES AND ISOLATED CUTICLES OF HEDERA HELIX L. AFTER WETTING WITH ARTIFICIAL RAINWATER,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
For primary bibliographic entry see Field 5C.
W88-01885

LIGHT AND NUTRIENTS IN THE CONTROL OF AQUATIC PLANT COMMUNITY STRUCTURE. II. IN SITU OBSERVATIONS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
P. A. Chambers.
Journal of Ecology JECOAB, Vol. 75, No. 3, p 621-628, September 1987. 3 fig, 1 tab, 25 ref.

Descriptors: *Light, *Aquatic plants, *Limnology, *Lakes, *Nutrients, *Ecosystems, Sediments, Soil fertility, Biomass, Vermont, Plant growth.

The biomass and growth-form composition of submerged plant communities growing along natural gradients of irradiance and sediment fertility were investigated to test the hypothesis that environment factors determine community composition. Increasing sediment fertility was associated with an increase in the proportion of the total plant biomass attributable to canopy-producing or erect growth forms and a decrease in the importance of rosette and bottom-dwelling forms. Comparison of the sediment and irradiance response under controlled conditions and in nature showed that each growth form achieved a biomass greater than or comparable with the other forms under similar conditions both in monoculture and in situ. These results suggest that the growth-form composition of aquatic plant communities is primarily determined by the physical environment. (See also W88-01980) (Author's abstract)
W88-01981

PHYSIOLOGICAL RESPONSES OF COTTON TO A SINGLE WATERLOGGING AT HIGH AND LOW N-LEVELS,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
For primary bibliographic entry see Field 3F.
W88-01992

EFFECT OF TRICKLE FERTIGATION WITH THREE FORMS OF NITROGEN ON SOIL PH, LEVELS OF EXTRACTABLE NUTRIENTS BELOW THE EMITTER AND PLANT GROWTH,
Ministry of Agriculture and Fisheries, Canterbury (New Zealand). Agricultural Research Div.
For primary bibliographic entry see Field 3F.
W88-01993

ANAEROBIC METABOLISM ENZYMES AS MARKERS OF FLOODING STRESS IN MAIZE SEEDS,
Agricultural Research Service, Columbus, OH.
T. T. Vantoai, N. R. Fausey, and M. B. McDonald.
Plant and Soil PLSOA2, Vol. 102, No. 1, p 33-39, 1987. 6 fig, 25 ref.

Descriptors: *Anaerobic metabolism, *Flooding, *Stress, *Corn, *Plant physiology, Seeds, Pyruvate decarboxylase, Alcohol dehydrogenase, Lactate dehydrogenase, Malic enzyme, Germination.

Maize (Zea mays L.) seeds differ in their relative tolerance to the anaerobic environment caused by flooding. Seed tolerance to flooding stress depends on cellular and metabolic processes since gross anatomical responses have not developed at the pre-emergence stage. The study reported here characterizes the activities of four anaerobic respiratory enzymes: pyruvate decarboxylase (PDC), alcohol dehydrogenase (ADH), lactate dehydrogenase (LDH), and malic enzyme (ME) in the flood-tolerant A632 and flood-susceptible Mo17 inbred maize seeds during flooding at 10 and 25 C. Each inbred consisted of two seed lots possessing 95% and 75% germination levels. Flooding increased the activities of all four enzymes. However, no consistent correlation between anaerobic enzyme activity and flood tolerance was observed across genotype, seed quality and flooding temperature. The results indicate that it may not be feasible to use whole-seed anaerobic enzyme activities to predict maize seed performance under flooding stress. (Author's abstract)
W88-01998

EVALUATION OF THE EFFECT OF CHEMICALS ON AQUATIC ECOSYSTEM BY OBSERVING THE PHOTOSYNTHETIC ACTIVITY OF A MACROPHYTE, PORPHYRA YEZOENSIS,
Tokyo Univ. of Fisheries (Japan). Dept. of Marine Environmental Science and Technology.
For primary bibliographic entry see Field 5C.
W88-02033

EFFECT OF RATE AND TIME OF APPLICATION OF NITROGEN IN COW SLURRY ON GRASS CUT FOR SILAGE,
Agricultural and Food Research Council (England). Bristol Lab.
For primary bibliographic entry see Field 5E.
W88-02069

EFFECT OF FERTILIZER, CHICKEN MANURE AND DAIRY MANURE ON TIMOTHY YIELD, TISSUE COMPOSITION AND SOIL FERTILITY,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Renewable Resources.
For primary bibliographic entry see Field 5E.
W88-02075

WATER UPTAKE BY ROOTS IN CRACKS AND WATER MOVEMENT IN CLAYEY SUBSOIL,
National Research Inst. of Agricultural Engineering, Yatabe (Japan).
S. Hasegawa, and T. Sato.
Soil Science SOSCAK, Vol. 143, No. 5, p 381-386, May 1987. 6 fig, 19 ref.

Descriptors: *Soil water, *Roots, *Geologic fractures, *Model studies, *Soil-water-plant relationships, *Clay, *Hydraulic conductivity, *Permeability coefficient, Rainfall, Crop water use, Plants.

The magnitude of soil water uptake by roots growing in cracks was evaluated using a simple crack model, and compared with upward soil water flux in a clayey soil. The physical quantities used in the model are crack spacing (D), depth of the cracks (H), water uptake rate per unit length of root (q), and root length density in the cracks (L). These values, except for q, were obtained from an upland field converted from a paddy field. Daily water uptakes per unit of ground surface by the model were 0.7-1.3 mm/d when q was 0.01-0.02 cu cm/cm/d and D was 15 cm, whereas, upward soil water fluxes calculated by hydraulic conductivities and soil water pressures were of the order of 0.01 mm/d 1 wk after a heavy rain (143 mm). Roots growing in the subsoil through the cracks, therefore, are very important for water consumption by crops. (Author's abstract)
W88-02330

QUANTITY AND QUALITY OF BRACKEN THROUGHFALL, STEMFLOW AND LITTERFLOW IN A DARTMOOR CATCHMENT,
Plymouth Polytechnic (England). Dept. of Geographical Sciences.
A. G. Williams, M. Kent, and J. L. Ternan.
Journal of Applied Ecology JAPEAI, Vol. 24, No. 1, p 217-230, April 1987. 2 fig, 5 tab, 42 ref.

Descriptors: *Bracken, *Throughfall, *Stemflow, *Litterflow, *Rainfall, *Canopy, Plants, Water chemistry, England, Catchments.

The importance of bracken (Pteridium aquilinum) invasion in the catchments of upland Britain is described and the potential influence of its growth and spread on both hydrological and nutrient cycles in such areas is introduced. Methods for the study of the quantity and quality of throughfall, stemflow and litterflow under typical bracken-infested Agrostis/Festuca pastures in an upland catchment on south-west Dartmoor, Devon, England, over a period of one year, are presented. Interception of incident rainfall over the 5-month bracken growth period was measured at 48.7%, while over the year, this was reduced to 20%. Throughfall and stemflow chemistry under bracken was shown to be significantly different from that of precipitation above the bracken canopy. Potassium was found to be the most important cation, comprising 40$ of total base cations in summer. Particularly high levels of potassium release were recorded in October during senescence and following the death of bracken fronds. Quantity and quality of litterflow were also measured. Most litterflow was locally derived and only travelled laterally through the litter layer for a few meters before passing into the soil to join the soil water. The chemical composition of litterflow was very different to that of throughfall and stemflow and there was a sixfold increase in potassium concentration in litterflow compared to throughfall and stemflow. Again, potassium release from bracken into litterflow was greatest in October. Mechanisms for the possible release of cations from bracken during its growth cycle are suggested. The implications of these results for the upland catchments of Britain, where bracken invasion is occurring are discussed. (Author's abstract)
W88-02365

DIURNAL AND SEASONAL VARIATION IN THE WATER RELATIONS OF SOME DECIDUOUS AND EVERGREEN TREES OF A DECIDUOUS DRY FOREST OF THE WESTERN COAST OF MEXICO,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Biologia.
L. Fanjul, and V. L. Barradas.
Journal of Applied Ecology JAPEAI, Vol. 24, No. 1, p 289-303, April 1987. 7 fig, 1 tab, 31 ref. Consejo Nacional de Ciencia y Tecnologia of Mexico Grant PCECBNA 022022.

Descriptors: *Plant water relations, *Tropical areas, *Leaves, *Water potential, *Seasonal variation, Evergreens, Water stress, Tolerance, Plants.

Diurnal and seasonal water relations were determined in leaves of Couepia colyandra Aubl., Thouinidium decandrum Radlk., Randia armata L. (evergreens); Trichilia trifolia L., Thouinia paucidentata Piot. (dry season deciduous); Jacquinia pungens A. Gray, Coccoloba liebmannii Lindau, and Forchhammeria pallida Liebm. (wet season deciduous) in a tropical dry-deciduous forest of the western Coast of Mexico, where the rainy season is from June to October. The difference in the minimal value of leaf water potential (psi) experienced by the wet-deciduous species between the dry and the rainy season was on average - 1.42 MPa, with absolute values of - 1.4 and - 3.0 MPa for February and April, respectively. This difference was only 0.48 MPa in the evergreen species. The minimum value of psi of the wet-deciduous species fell from - 2.5 MPa and - 1.2 MPa in February for J. pungens and C. liebmannii, respectively, to - 3.7 and - 3.0 MPa in April. The difference in the minimum values of turgor potential registered between the wet and the dry season was considerably less than the difference registered in psi. The maximum value of the modulus of elasticity (Eta sub max) varied widely between species and time of the year. The three wet-deciduous species showed the highest values of Eta sub max, ranging from 35-50 MPa in November to 20-25 MPa in February. The seasonal change in Eta sub max of the evergreen species showed a similar trend but at a lower level (23-25 MPa in November, to 8-12 in July). The dry-deciduous species showed the lowest Eta sub max ranging from 7 to 11 MPa in November but with little change in February. Evergreen and wet-deciduous species showed a higher capacity to tolerate water stress than the dry-deciduous species. (Author's abstract)
W88-02366

RESPONSE OF TWO WESTERN CANADIAN CONIFERS TO SIMULATED ACIDIC PRECIPITATION,
Saskatchewan Research Council, Saskatoon.
For primary bibliographic entry see Field 5C.
W88-02464

PHYSIOLOGICAL RESPONSES OF SOYBEAN (GLYCINE MAX L. MERR) TO SIMULATED ACID RAIN AND AMBIENT OZONE IN THE FIELD,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W88-02473

2J. Erosion and Sedimentation

SUMMARY OF THE POINTE MOUILLEE CONFINED DISPOSAL FACILITY,
Army Engineer District, Detroit, MI.
For primary bibliographic entry see Field 5E.
W88-01523

IMPROVING CHANNEL RELIABILITY AND PROTECTING THE ENVIRONMENT: A BALANCED APPROACH AT READS LANDING,
Army Engineer District, St. Paul, MN.
For primary bibliographic entry see Field 8A.
W88-01525

SILT CONCENTRATION MEASUREMENTS,
Rotterdam Public Works Dept. (Netherlands).
For primary bibliographic entry see Field 7A.
W88-01527

DREDGING AS A CLEANUP METHOD FOR AN INDUSTRIALIZED BAY,
Army Engineer District, Seattle, WA. Seattle District.
For primary bibliographic entry see Field 5G.
W88-01539

HYBRID MODELING TO REDUCE MAINTENANCE DREDGING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
W. H. McAnally.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 263-267, 2 fig, 2 ref, append.

Descriptors: *Model studies, *Dredging, *Hybrid modeling, Sedimentation, Hydraulic models, Mathematical models.

The hybrid modeling approach integrates physical modeling, numerical modeling, and analytical methods to produce results that are superior to other methods of predicting harbor sedimentation. The hybrid method has been described previously, but in brief, it applies each method to those processes for which it is best suited. For example, a physical model is used to describe three-dimensional hydrodynamics. Integrating the various solution methods permits the modeler to take advantage of the strengths of each method while avoiding its weaknesses. In this way, more processes can be modeled more accurately. This study indicates that the hybrid modeling approach, using TABS-2, provides an excellent tool for evaluation plans to reduce navigation channel maintenance. (See also W88-01522) (Lantz-PTT)
W88-01548

STUDY OF THE IMPACTS OF REDUCED DREDGING PROCEDURES ON THE NAVIGABILITY OF THE UPPER MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
L. L. Daggett.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 274-279, 5 fig.

Descriptors: *Dredging, *Mississippi River, *Navigation, Channels, Maintenance, Navigation channels, Channel maintenance, Sedimentation.

A study was designed to investigate the effects of channel width and depth on tow maneuvering capabilities in as realistic an environment as possible. Five cases were included in the test runs. The first channel condition was the surveyed bottom condition at a time when it was determined that dredging should be scheduled, i.e., minimum channel conditions. This was nominally an 11- by 300-ft channel. Three other conditions were included in which the channel was dredged to provide a 13- by 300-ft, an 11- by 450-ft, and a 13- by 450-ft channel. The fifth case consisted of the minimum channel with the emergency condition. Each of the conditions tested was developed by establishing the bottom contours expected following dredging. Then a two-dimensional model of the water currents for the test flow condition of 19,000 cu ft/sec was used to develop the velocity patterns expected with the respective channels. The Coast Guard District responsible for the aids-to-navigation established the buoy locations for each channel condition and the existing day markers were included in the visual and radar scenes. (See also W88-01522) (Lantz-PTT)
W88-01550

UNIQUE DESIGN ASPECTS OF A LARGE-SCALE EXPERIMENTAL SAND BYPASSING SYSTEM,
Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 8A.
W88-01551

SIMULATION STUDY OF THE NAVIGABILITY OF THE MAIN SHIP CHANNEL IN MOBILE HARBOR,
National Maritime Research Center-Kings Point, NY. Computer Aided Operations Research Facility.
For primary bibliographic entry see Field 8A.
W88-01552

SEDIMENTATION AND THE ECONOMICS OF SELECTING AN OPTIMUM RESERVOIR SIZE,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
D. Miltz, and D. C. White.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1443-1448, August 1987. 5 fig, 4 tab, 12 ref, append.

Descriptors: *Reservoir size, *Sedimentation rates, *Reservoir construction, *Economic aspects, *Costs, *Reservoir silting, Operating costs, Construction costs, Dredging costs, Sedimentation, Mathematical equations, Reservoirs, Reservoir capacity, Construction, Capacity, Silting, Highland Silver Lake, Illinois.

An easily reproducible methodology was developed for the economic selection of an optimal reservoir size given an annual sedimentation rate. The optimal capacity is that at which the marginal cost of constructing additional capacity is equal to the dredging costs avoided by having that additional capacity available to store sediment. The cost implications of misestimating dredging costs, construction costs, and sediment delivery rates are investigated. In general, it is shown that oversizing is a rational response to uncertainty in the estimation of parameters. The sensitivity of the results to alternative discount rates is also discussed. The theoretical discussion is illustrated with a case study drawn from Highland Silver Lake in southwestern Illinois. (Author's abstract)
W88-01676

CALCULATIONS OF THE CRITICAL SHEAR STRESS FOR MOTION OF UNIFORM AND HETEROGENEOUS SEDIMENTS,
Washington Univ., Seattle. Geophysics Program.
P. L. Wiberg, and J. D. Smith.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1471-1480, August 1987. 14 fig, 29 ref. NSF Grant OCE-8310712.

Descriptors: *Sediment transport, *Critical shear stress, *Bed load, *Shear stress, *Mathematical equations, Data interpretation, Particle size, Density, Drag, Sedimentation, Mathematical studies.

An expression for the critical shear stress of noncohesive sediment is derived from the balance of forces on individual particles at the surface of a bed. The resulting equation, for a given grain size and density, depends on the near-bed drag force, lift force to drag force ratio, and particle angle of repose. Calculated values of the critical shear stress for uniformly sized sediment correspond closely to those determined from Shields' diagram. The initial motion problem for mixed grain sizes additionally depends on the relative protrusion of the grains into the flow and the particle angle of repose. The latter decreases when the diameter of a moving grain, D, is larger than the length scale of the bed roughness, k sub s (D/k sub s $>$ 1), and increases when D/k sub s $<$ 1, producing a corresponding decrease or increase in critical shear stress. Using the Miller and Byrne experimental relationship between D/k sub s and particle angle of repose, which is consistent with Shields' definition of initial motion, results are obtained that are in good agreement with the available experimental critical shear stress data for heterogeneous beds. (Author's abstract)
W88-01680

DREDGE ENVIRON PROTECTION ASSEMBLY,
For primary bibliographic entry see Field 5G.
W88-01784

GEOCHEMISTRY OF THE AMAZON: 3. WEATHERING CHEMISTRY AND LIMITS TO DISSOLVED INPUTS,
Princeton Univ., NJ. Dept. of Geological and Geophysical Sciences.
R. F. Stallard, and J. M. Edmond.
Journal of Geophysical Research (C) JGRCEY, Vol. 92, No. 8, p 8293-8302, July 15, 1987. 6 fig, 43 ref. NSF grant OCE77-27148.

Descriptors: *River systems, *Weathering, *Geochemistry, *Carbonate rocks, *Erosion, Silicates, Clays, Surface-groundwater relations, Alkalinity, Solutes, Solute transport, Cations, Calcium, Magnesium, Kaolinite, Dolomite, Quartz.

Chemical mass balance models of river solution chemistry, constrained by geologic data and thermodynamic models, provide a consistent description of the weathering processes that occur in the Amazon basin. In areas with high weathering rates, such as the Andes, calcium, magnesium, sulfate and alkalinity come from the weathering of evaporite minerals, sulfides, and carbonates. The inputs of calcium, magnesium, and alkalinity from exclusively carbonate terrains are limited by calcite, and perhaps by dolomite, saturation. When evaporites are present, only the alkalinity inputs are so limited because of additional weathering sources of calcium and magnesium. Dissolved silica, potassium and sodium can be used to define mass balance relationships that in turn establish the nature of the clay mineral suites which are consistent with solute compositions. Use of thermodynamic constraints, specifically kaolinite and quartz stability, assists in data interpretation. At lowest weathering rates, all common primary minerals exposed to weathering are broken down to release silica and cations. Quartz, kaolinite and (Fe, Al)-sesquioxides all appear to be unstable. At higher weathering rates, enough silica is available to stabilize kaolinite, then quartz. The stabilization of silicon-bearing phases is reflected by a drop in the ratio of silica to other dissolved components. Finally, at the highest weathering rates, such as in the Andean catchments, high cation levels result in the formation of the 2:1 clays, which sequester even more silica, and any clear relationship between silica and other solutes degenerates. (Author's abstract)
W88-01809

ERODIBLE LAND AND STATE WATER QUALITY PROGRAMS: A LINKAGE,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 5G.
W88-01883

PREDICTION OF WIND WAVE CHARACTERISTICS IN LARGE CANALS,
For primary bibliographic entry see Field 8B.
W88-01910

STOCHASTIC MODEL FOR THE LONG-TERM TRANSPORT OF STORED SEDIMENT IN A RIVER CHANNEL,
Western Washington Univ., Bellingham. Dept. of Geology.
H. M. Kelsey, R. Lamberson, and M. A. Madej.
Water Resources Research WRERAQ, Vol. 23, No. 9, p 1738-1750, September 1987. 6 fig, 6 tab, 27 ref, append.

Descriptors: *Stochastic models, *Stochastic hydrology, Stochastic process, *Sediment transport, *Rivers, *Channel morphology, *Model studies, *Sediment storage, Channels, Sediments, Sediment distribution, Seasonal variation, California, Redwood Creek, Mathematical equations, Mathematical studies, Reservoirs.

A stochastic model is developed for the transport of stored sediments down a river channel. The model is based on probabilities of transition of particles among four different sediment storage reservoirs, called active (often mobilized), semiactive, inactive, and stable (hardly ever mobilized). The probabilities are derived from computed residence times. Two aspects of sediment storage are investigated: flushing times of sediment out of a storage reservoir and changes in the quantity of sediment stored in different reservoirs due to seasonal sediment transport into, and out of, a reach. The model is applied to Redwood Creek, a gravel bed river in northern California. Although the Redwood Creek data set is incomplete, the application serves as an example of the sorts of analyses that can be done with the method. The application also provides insights into the sediment storage process. Sediment flushing times are highly dependent on the degree of interaction of the stable reservoir with the more mobile sediment reservoirs. The most infrequent and highest intensity storm events, which mobilize the stable reservoir, are responsible for the long-term shifts in sediment storage. Turnover times of channel sediment in all but the stable reservoir are on the order of 750 years, suggesting this is the time needed for thorough interchange between these sediment compartments and cycling of most sediment particles from the initial reservoir to the ocean. Finally, the Markov model has adequately characterized sediment storage changes in Redwood Creek for 1947-1982, especially for the active reservoir. The model replicates field observation of the passage of a slug of sediment through the active reservoir of the middle reach of Redwood Creek in the 18 years following a major storm in 1964 that introduced large quantities of landslide debris to the channel. (Author's abstract)
W88-01913

CONVECTIVE TRANSPORT WITHIN STABLE RIVER SEDIMENTS,
Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.
S. A. Savant, D. D. Reible, and L. J. Thibodeaux.
Water Resources Research WRERAQ, Vol. 23, No. 9, p 1763-1768, September 1987. 6 fig, 2 tab, 16 ref.

Descriptors: *Sediment transport, *River sediments, *Sediments, *Path of pollutants, *Pollutant transport, *Convective transport, Sediment-water interfaces, Model studies, Mathematical models, Mathematical equations, Pressure distribution, Rivers, Interstitial water, Pollutants, Convection.

Local pressure variations of the order of 100-1000 Newtons/sq m can be observed between the upstream and downstream faces of the typically triangular-shaped dunelike sediment structures that form at the sediment-water interface of rivers. Laboratory experiments were conducted examining the influence of this localized pressure variation on contaminant transport processes within the sediment. Numerical modeling of the in-bed flow via boundary element methods was also undertaken in order to predict convective transport under typical field conditions. The laboratory experiments and numerical simulation of the in-bed flow in several rivers verified that the pressure distribution observed on the sediment surface and the resulting interstitial fluid convection can control transport of chemically inert, nonsorbed contaminants in stable sediments. In-bed Peclet numbers were of the order of 100-1000, indicating the negligible influence of diffusion under the conditions examined. (Author's abstract)
W88-01916

MATHEMATICAL MODEL FOR UNSTEADY SUPERCRITICAL FLOW ON A MOBILE SANDY BED,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ingenieria.
For primary bibliographic entry see Field 2E.
W88-01963

MACROSCALE ANALYSIS OF UPLAND EROSION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
P. Y. Julien, and M. Frenette.
Hydrological Sciences Journal HSJODN, Vol. 32, No. 3, 347-358, September 1987. 11 fig, 1 tab, 12 ref.

Descriptors: *Erosion, *Mathematical analysis, *Chaudiere basin, Sheet erosion, Rill erosion, Mathematical studies.

Scale effects in computing sheet and rill erosion losses from large basins have been studied for grid sizes ranging from 0.03 to 4 sq km over drainage areas up to 3000 sq km. As a result of the analysis conducted on the Chaudiere basin (5830 sq km), the mean characteristics of the basin can be used to estimate the mean annual upland erosion losses after a correction factor for the influence of grid size is introduced into the calculation. The use of fine-meshed grids can be justified when information on the areal distribution of soil erosion is desired. (Author's abstract)
W88-01965

ANALYSIS OF STRATIGRAPHIC CONTROL ON RIVER BANK FAILURE,
Nigeria Univ., Nsukka. Dept. of Geology.
For primary bibliographic entry see Field 8D.
W88-01994

EFFECT OF CARBOHYDRATE IN THE SEDIMENT ON THE MUSTY ODOR PRODUCTION BY ACTINOMYCETES,
National Inst. for Environmental Studies, Yatabe (Japan).
For primary bibliographic entry see Field 2H.
W88-02013

MEASUREMENT OF CADMIUM ADSORPTION ON SEDIMENTS OF LAKE COMABBIO - NORTH ITALY (MESURES D'ADSORPTION DU CADMIUM SUR LES SEDIMENTS DU LAC DE COMABBIO - ITALIE DU NORD),
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 5B.
W88-02016

ADSORPTION OF COPPER, ZINC AND LEAD BY BED SEDIMENTS OF RIVER GANGES IN INDIA,
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-02021

AEOLIAN CONTRIBUTIONS OF TRACE METALS TO MARINE SEDIMENTS OF KUWAIT,
Kuwait Inst. for Scientific Research, Safat. Environmental and Earth Sciences Div.
For primary bibliographic entry see Field 5B.
W88-02024

EVALUATION OF THE REPARTITION OF PCBS BETWEEN DISSOLVED AND PARTICULATE MATTER IN RIVER SEINE (FRANCE) (EVALUATION DE LA REPARTITION PARTICULAIRE/AQUEUSE DES PCB (POLYCHLOROBIPHENYLES) EN SEINE),
Paris-6 Univ. (France). Inst. d'Hydrologie et de Climatologie.
For primary bibliographic entry see Field 5B.
W88-02106

EVALUATION OF THE FLUID DYNAMIC PROPERTIES OF MUD FLOWS ON MOUNT ST HELENS,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
T. E. Lang, and J. D. Dent.
Available from the National Technical Institute Service, Springfield, VA 22161, as PB87 218236/AS, price codes: A05 in paper copy, A01 in microfiche. Final Report, March 1983. 78 p, 32 fig, 7 tab, 22 ref, 4 append. Project C-10042-V(1). Department of the Interior Contract No. 14-4-0001-1471.

Descriptors: *Mount Saint Helens, *Mudflows, *Muddy Creek, *Pine Creek, *Toutle River, *Computer models, *Swift Reservoir, Erosion, Flow characteristics, Drainage, Channel flow, Kinematics, Mathematical studies, Flow velocity, Snowpack, Volcanoes, Mud.

Findings of a computer based study of the mudflows on Mt. St. Helens following its' eruption on 18 May 1980 are summarized. The analyses were divided into two parts. Part one concerned the start-up dynamics and flow of mud down the various drainages of Mt. St. Helens. Part two concerned the termination of the Pine Creek mudflow into Swift Reservoir. The flow analysis in the Muddy Creek, Pine Creek and Toutle River drainages was undertaken first. Parameters of this flow were evaluated in order to establish a basis for general analysis of mud flow phenomena. Starting with estimates of snow deposition on the mountain, and incorporating the characteristics of the pyroclastic blast of the eruption, initiation of flow was approximated. With flow established, different aspects of the computer modeling were evaluated for the different drainages. Then for the North and South Toutle River drainages, equilibrium flow conditions were established, from which kinematic viscosity and the Manning's numbers of the flows were determined. For the East Pine Creek and Muddy River drainages, a complete flow analysis was carried out which includes initiation of flow, progression of the flow analysis was carried out which includes initiation of flow, progression of the flow through the channels, and final terminal flow into Swift Reservoir. Time sequencing of the flows with reservoir elevation changes was correlated, based upon available data. Additionally, kinematics of the flows were compared with corresponding field measured quantities where possible. In Part II the mudflow from Pine Creek is modeled as it terminated into Swift Reservoir. Flow conditions from Part I were used as initial conditions for this analysis. A two-dimensional, incompressible, linear viscous computer model was used to evaluate the interaction between the inflowing mud and the stationary reservoir. This analysis produced an amplitude and velocity of the resulting surge wave that agrees with the recordings made at the time of the event. (Author's abstract)
W88-02270

SCOUR PROTECTION FOR LOCKS AND DAMS 2-10, UPPER MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W88-02283

GABIONS USED IN STREAM GRADE-STABILIZATION STRUCTURES: A CASE HISTORY,
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4D.
W88-02356

ENHANCEMENT OF RIPARIAN ECOSYSTEMS WITH CHANNEL STRUCTURES,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
For primary bibliographic entry see Field 4A.
W88-02385

EFFECT OF CULTIVATION ON SEDIMENT COMPOSITION AND DEPOSITION IN PRAIRIE POTHOLE WETLANDS,
National Fisheries Contaminant Research Center, Yankton, SD. Field Research Station.
D. B. Martin, and W. A. Hartman.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 1, p 45-53, May 1987. 1 fig, 3 tab, 18 ref.

Descriptors: *Sedimentation, *Sediments, *Cultivation, *Wetlands, *Prairie potholes, *Deposition, Watersheds, Runoff, Agriculture, Nutrients, Grasses.

Texture, major nutrient content, and deposition rate of sediments were compared for five prairie pothole wetlands surrounded by native grassland and seven otherwise similar wetlands surrounded by row crop and small grain farmland. Specific differences in the nature of the sedimentation cycle of cultivated and noncultivated watersheds were indicated. Flux of total inorganic material into sediments averaged 80 and 43 mg cu/y in cultivated and grassland wetlands, respectively. Cultivated sediments contained significantly higher clay percentages, but lower percentages of silt and sand than grassland sediments. Deposition rates of clay at cultivated sites averaged five times that of grassland locations. Enrichment ratios (the quotient of sediment concentration divided by upland soil concentrations) suggested that sand was selectively retained in equal proportions on uplands in both types of watersheds, that silt was selectively removed (although in different proportions) from uplands in both types of watersheds, and that clay was selectively retianed only on grasslands. Total N and organic matter concentrations were significantly higher in both the soils and sediments of grassland watersheds, but there were no differences in total P concentrations with respect to land use. Sediment flux rates for total N and organic matter were similar in the two land use types; however, P was transported at nearly twice the rate to cultivated wetlands. Enrichment ratios indicated that N and P were selectively removed in similar proportions from upland soils in both types of watersheds. (Author's abstract)
W88-02477

2K. Chemical Processes

BIOMEMBRANES, PART O, PROTONS AND WATER: STRUCTURE AND TRANSLOCATION.
For primary bibliographic entry see Field 1B.
W88-01593

METHODS TO DETERMINE STRUCTURE IN WATER AND AQUEOUS SOLUTIONS,
State Univ. of New York at Stony Brook. Dept. of Chemistry.
For primary bibliographic entry see Field 1B.
W88-01594

LOW-FREQUENCY RAMAN SCATTERING FROM WATER AND AQUEOUS SOLUTIONS: A DIRECT MEASURE OF HYDROGEN BONDING,
Howard Univ., Washington, DC. Dept. of Chemistry.
For primary bibliographic entry see Field 1B.
W88-01595

DIFFRACTION TECHNIQUES FOR THE STUDY OF PURE WATER AND AQUEOUS SOLUTIONS,
Institut Max von Laue - Paul Langevin, Grenoble (France).
For primary bibliographic entry see Field 1B.
W88-01597

GEOCHEMICAL EVOLUTION OF GROUNDWATER IN STRATIFIED-DRIFT AND ARKOSIC BEDROCK AQUIFERS IN NORTH CENTRAL CONNECTICUT,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W88-01686

TRANSPORT OF REACTING SOLUTES SUBJECT TO A MOVING DISSOLUTION BOUNDARY: NUMERICAL METHODS AND SOLUTIONS,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W88-01689

BACTERIA IN DEEP COASTAL PLAIN SEDIMENTS OF MARYLAND: A POSSIBLE SOURCE OF CO2 TO GROUNDWATER,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 2F.
W88-01694

GEOCHEMISTRY OF THE AMAZON: 3. WEATHERING CHEMISTRY AND LIMITS TO DISSOLVED INPUTS,
Princeton Univ., NJ. Dept. of Geological and Geophysical Sciences.
For primary bibliographic entry see Field 2J.
W88-01809

ROLE OF FE(III) IN METAL COMPLEX ADSORPTION BY HYDROUS SOLIDS,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
A. R. Bowers, and C. P. Huang.
Water Research WATRAG, Vol. 21, No. 7, p 757-764, July 1987. 8 fig, 2 tab, 24 ref. NSF Grant No. CEE 8104728.

Descriptors: *Iron, *Heavy metals, *Adsorption, *Chemical reactions, Path of pollutants, Laboratory analysis, Chemical analysis, Metal complexes, Nickel, Lead, Zinc.

The effect of Fe(III) on the adsorptive behavior of complexed Ni(II), Pb(II) and Zn(II) by hydrous solids (gamma-Al2O3, SiO2 and mordenite) has been examined in the laboratory. Ethylene-diaminetetraacetic acid (EDTA) and 1,2-dihydroxybenzene-3, 5 disulfonic acid (Tiron) were used as strong organic complex formers. Iron(III) was found to have stronger complex formation constants than the divalent metals; however, the pH-dependent conditional constants indicated that the organic ligands would favor Fe(III) in the low pH range (approximately <5), whereas the divalent metals are favored at the high pH's (approximately >6). The partitioning of organic ligands between Fe(III) and the divalent metals as a function of pH was shown to play a significant role in the adsorptive behavior of the complexed divalent metals. When present at low concentration (<0.000001), the divalent metals adsorbed in a 'metal-like' manner when Fe(III) was present, compared to a 'ligand-like' behavior when Fe(III) was not available to compete for the organic ligand. At high concentrations (0.0001 M), Ni(II) behaved in a 'ligand-like' manner due to the comparatively low solubility of the Fe(3+) species, while Pb(II) and Zn(II) exhibited a transitory behavior, somewhere between the 'free' and the complexed metal species. (Author's abstract)
W88-01835

CONTROL OF EUTROPHICATION OF LAKES AND RESERVOIRS BY MEANS OF PRE-DAMS. II. VALIDATION OF THE PHOSPHATE REMOVAL MODEL AND SIZE OPTIMIZATION,
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
For primary bibliographic entry see Field 5G.
W88-01845

MEASUREMENT OF THE MASS ACCOMMODATION COEFFICIENT OF SO2 (G) ON WATER DROPLETS,
Boston Coll., Chestnut Hill, MA. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W88-01859

FLUORIMETRIC DETERMINATION OF NITRATE IN NATURAL WATERS WITH 3-AMINO-1,5-NAPHTHALENEDISULPHONIC ACID IN A FLOW-INJECTION SYSTEM,
Okayama Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-01870

LIGNIN GEOCHEMISTRY OF SEDIMENTS FROM THE NARRAGANSETT BAY ESTUARY,
Battelle New England Marine Research Lab.,

Duxbury, MA.
For primary bibliographic entry see Field 2L.
W88-01970

PREDICTION OF BORATE MINERAL EQUILIBRIA IN NATURAL WATERS: APPLICATION TO SEARLES LAKE, CALIFORNIA,
California Univ., San Diego, La Jolla. Dept. of Chemistry.
A. R. Felmy, and J. H. Weare.
Geochimica et Cosmochimica Acta GCACAK, Vol. 50, No. 12, p 2771-2783, December 1986. 14 fig, 14 tab, 29 ref, append. ACS Grant 14550-AC2, 5-C, DOE Grant DE-AC03-85SF 15522, and NSF Grant OCE 85-07902.

Descriptors: *Searles Lake, *California, *Chemical precipitation, *Borate, Minerals, Chemical analysis, Geochemistry, Lakes.

The chemical equilibrium model of Harvie has been extended to include borate species. The model is based upon the semi-empirical equations of Pitzer and is valid to a high ionic strength (approximately 14 m) and high borate concentration. Excellent agreement with the existing emf, isopiestic, and solubility data in the system (Na-K-Ca-Mg-H-Cl-SO4-CO2-B(OH)4-H2O) was obtained. Calculated mineral solubilities are in general within 10% of their experimental values, even at high ionic strengths. The model was applied to the multicomponent, high ionic strength (I approximately 10) and high borate concentration (B sub tau approximately 0.5 m) Searles Lake evaporite deposit. Utilizing the chemical composition of the interstitial brine, the model predicts equilibrium between the brine and only those minerals which are known to be in contact with the brine. These calculations demonstrated the applicability of the model to high ionic strength, high borate concentration natural waters. The model was also used to calculate the mineral sequences which should result from evaporation of the major source of water for Searles Lake, the Owens River. The geochemical conditions necessary for the formation of the most recent mud and saline units were examined. The final results indicate that the mineral sequences found in the most recent saline unit in Searles Lake can be produced by evaporation of a water close in composition to present Owens River water, provided primary dolomite formation is delayed and back reaction between the Parting Mud and the Upper Salt is inhibited. (Author's abstract)
W88-01971

PREPARATION OF ENVIRONMENTAL SAMPLES FOR THE DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS BY THIN-LAYER CHROMATOGRAPHY,
Wayne State Univ., Detroit, MI. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W88-01983

DETERMINATION OF TRACE LEVELS OF PHENOL AND CRESOLS IN RAIN BY CONTINUOUS LIQUID-LIQUID EXTRACTION AND HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5A.
W88-01984

NITROGEN EXCHANGE BETWEEN A SOUTHEASTERN USA SALT MARSH ECOSYSTEM AND THE COASTAL OCEAN,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
For primary bibliographic entry see Field 2L.
W88-01995

VARIATION IN APPARENT TRACE METAL COMPLEXING CAPACITY OF NATURAL WATERS WITH PLATING POTENTIAL USING ANODIC STRIPPING VOLTAMMETRY,
Western Australia School of Mines, Kalgoorlie.
For primary bibliographic entry see Field 2H.
W88-02015

ADSORPTION OF COPPER, ZINC AND LEAD BY BED SEDIMENTS OF RIVER GANGES IN INDIA,
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-02021

STUDIES OF HUMIC AND FULVIC ACID DYNAMICS IN COASTAL MARINE WATERS OF SOUTH FLORIDA,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 2L.
W88-02056

REACTION MECHANISMS OF POLYCHLORINATED DIBENZO-P-DIOXINS AND POLYCHLORINATED DIBENZOFURANS DURING OZONATION OF WATER SAMPLES (REAKTIONSVERHALTEN POLYCHLORIERTER DIBENZO-P-DIOXINE UND POLYCHLORIERTER DIBENZOFURANE BEI DER OZONUNG VON WAESSERN),
Institut Fresenius Chemische und Biologische Laboratorien G.m.b.H., Taunusstein-Neuhof (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W88-02084

SOLUBLE SALT CONTENT OF THE ALLUVIAL BANKS OF A SEMI-ARID TRIBUTARY CATCHMENT OF THE GREAT FISH RIVER,
Rhodes Univ., Grahamstown (South Africa). Hydrological Research Unit.
For primary bibliographic entry see Field 2G.
W88-02090

GROUNDWATER FLOW PATHS AND HYDROGEOCHEMISTRY IN DEEP GRANITES AND GNEISSES (GRUNDWASSERFLIESSWEGE UND HYDROGEOCHEMIE IN TIEFEN GRANITEN AND GNEISEN),
Abteilung Umweltschutz des Kantons Aargau, Aarau (Switzerland).
For primary bibliographic entry see Field 2F.
W88-02097

QUANTITY AND QUALITY OF BRACKEN THROUGHFALL, STEMFLOW AND LITTERFLOW IN A DARTMOOR CATCHMENT,
Plymouth Polytechnic (England). Dept. of Geographical Sciences.
For primary bibliographic entry see Field 2I.
W88-02365

COMPUTER MODELLING STUDY OF THE CHEMISTRY OCCURRING DURING CLOUD FORMATION OVER HILLS,
UKAEA Atomic Energy Research Establishment, Harwell (England).
A. M. Hough.
Atmospheric Environmental ATENBP, Vol. 21, No. 5, p 1073-1095, May 1987. 14 fig, 5 tab, 43 ref, 2 append.

Descriptors: *Atmospheric chemistry, *Clouds, *Water chemistry, *Model studies, *Acid rain, *Path of pollutants, *Cloud chemistry, Aerosols, Ions, Acidity, Oxidation.

Acidity of cloud droplets was studied using a model has been developed which describes the chemical processes occurring during the formation of hill cloud. This model has been applied to the study of four cases which should be typical of the chemical conditions which can exist during the formation of such cloud over hills in the N of England. The results show that a wide range of chemical behavior is possible in cloud droplets, depending on the history of the airmass. The composition of the water-soluble aerosol is of importance in determining the chemical composition of cloud droplets, with most of the sulfate and large proportions of the other ions being derived from this source. Gas-phase chemistry is also important, not only because it dictates the initial concentrations of oxidants such as H2O2 and O3 and of acidic gases such as HNO3 at the onset of condensation, but also because of the chemical processes which occur concurrently with those in clouds. These are important sources of radicals, as well as of nitric acid, which continue to dissolve in solution. Gas-phase HCl, HNO3 and NH3 are all of primary importance in describing the acidity of cloud droplets. The various oxidation mechanisms for SO2 can all be important, with their relative contributions varying from case to case. H2O2 does not invariably dominate this process, especially in winter when its concentration may be low. The chemistry of hill clouds is far from trivial and oversimplification can result in a misunderstanding of the behavior which occurs. There is a need, rather, to consider a wide range of reactions if the nature of the overall processes and the impact of manmade emissions on the environment via this route are to be understood. (Author's abstract)
W88-02402

OXIDATION OF SO2 IN RAINWATER AND ITS ROLE IN ACID RAIN CHEMISTRY,
Leeds Univ. (England). Dept. of Fuel and Energy.
For primary bibliographic entry see Field 5B.
W88-02405

INFLUENCE OF ALKALINE PARTICULATES ON PH OF CLOUD AND RAIN WATER IN INDIA,
Indian Inst. of Tropical Meteorology, Poona.
L. T. Khemani, G. A. Momin, M. S. Naik, P. S. P. Rao, and P. D. Safai.
Atmospheric Environmental ATENBP, Vol. 21, No. 5, p 1137-1145, May 1987. 5 fig, 1 tab, 54 ref.

Descriptors: *Cloud chemistry, *Rainfall, *Alkalinity, *Cloud liquid water, *Acid rain, *Path of pollutants, *Fate of pollutants, *Water analysis, Ions, Metals, Chlorides, India.

Cloud and rain water samples were collected on board aircraft by specially designed equipment, during three monsoon seasons, 1983, 1984 and 1985 in the Pune region in India. The samples were analyzed for major ionic components and pH, and the concentrations of all the ionic components were found to be significantly higher (35-161%) in cloud water than in rain water. In cloud water Cl contributed most (35%) to the total ionic concentration followed by Ca (21%) and Na (17%). Sulfate and nitrate concentrations, on the average, were low and were found to account for only 6% of the total ionic concentration. pH of cloud water and rain water was substantially higher than that of the CO2-equilibrated value (5.6). The findings suggest that influence of anthropogenic sources is negligible and that of soil dust which is alkaline is substantial on the pH and chemistry of cloud/rain water in India. (Author's abstract)
W88-02408

CHEMICAL COMPOSITION OF PRECIPITATION AT MARION ISLAND (SUB-ANTARCTIC),
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Botany.
V. R. Smith.
Atmospheric Environmental ATENBP, Vol. 21, No. 5, p 1159-1165, May 1987. 2 fig, 2 tab, 41 ref.

Descriptors: *Atmospheric chemistry, *Water chemistry, *Precipitation, *Ions, *Marion Island, Metals, Chlorides, Nutrients, Antarctic.

Over a 1-year period 16.40 g Cl(-)/sq m, 10.35 g Na/sq m, 2.11 g SO4-S/sq m, 1.24 g Mg/sq m, 0.39 g K/sq m, 0.37 g Ca/sq m and 0.21 g inorganic N/sq m were deposited in precipitation 450 m inland on the eastern coastal plain of sub-Antarctic Marion Island (46 deg 54 min S, 37 deg 45 min E). Dissolved PO4-P and organic forms of N were not detected in the precipitation samples. Concentrations of Cl(-), Na, Mg, Ca and K, as well as the total ionic concentration in the precipitation sam-

ples were significantly negatively correlated with the amount of precipitation. The ionic concentration order (Cl > Na > SO4-S > Mg > K + Ca) in the precipitation was very similar to that in the surrounding ocean. It is likely that most of the inorganic N found in the precipitation originated in penguin rookeries on the nearby shore zone. A comparison is made between precipitation inputs of nutrients at the island and those at other subpolar sites in the S and N Hemispheres. (Author's abstract)
W88-02410

DEPOSITION OF NITRATE-N AND SULFATE-S BY PRECIPITATIONS IN SCHLESWIG-HOLSTEIN,
Kiel Univ. (Germany, F.R.). Inst. fuer Pflanzenernaehrung und Bodenkunde.
For primary bibliographic entry see Field 2B.
W88-02411

VARIATIONS IN THE 87SR/86SR RATIO IN LAKE WATERS FROM CENTRAL SWEDEN,
Stockholm Univ. (Sweden). Dept. of Geology.
F. E. Wickman, and G. Aberg.
Nordic Hydrology NOHYBB, Vol. 18, No. 1, p 21-32, 1987. 7 fig, 4 tab, 10 ref. Swedish National Research Council Grants Nos G-GU 4141-107 and G-GU/RT 4141-109.

Descriptors: *Isotope studies, *Strontium isotopes, *Limnology, *Hydrology, *Geochemistry, *Radioactive dating, *Tracers, *Lakes, Sweden, Geology, Bedrock, Weathering, Snow.

The 87Sr/86Sr ratios of lake waters from eastern Central Sweden, a region consisting mainly of 1.7-2.0 times ten to the 9th power years old granitoid rocks are reported and discussed. The ratios range from 0.722-0.739, and are similar to lake and stream waters in geologically similar areas. The annual variation of the isotope ratio in two small lakes varied in the range of 0.7323-0.7339 and 0.7313-0.7325 respectively, except at ice clearing in spring when the ratio of surface water was lowered by a contribution from melting snow. Small lateral differences also exist in Lake Malaren, probably because its complex outline hinders complete mixing of its water. The Sr isotopic ratio variations with respect to bedrock geology suggest that a more important influence on the ratio is the mineralogic composition of the Quaternary depostis (mainly till). The great difference between the ratios of rain water (0.709-0.710) and those of rocks in old Precambrian platforms with granitic rocks (0.720 and greater) results in waters (ground, lake and river) with ratios around 0.720-0.740. This means that the 87Sr/86Sr ratio is an excellent tool in studies of hydrologic processes, such as mixing of waters and exchange reactions between water and mineral matter. (See also W88-02440) (Author's abstract)
W88-02439

VARIATIONS OF 87SR/86SR IN WATER FROM STREAMS DISCHARGING IN THE BOTHNIAN BAY, BALTIC SEA,
Royal Inst. of Tech., Stockholm (Sweden). Institutionen foer Kulturteknik.
F. Aberg, and F. E. Wickman.
Nordic Hydrology NOHYBB, Vol. 18, No. 1, p 33-42, 1987. 3 fig, 2 tab, 5 ref.

Descriptors: *Streams, *Isotope studies, *Strontium isotopes, *Limnology, *Radioactive dating, *Tracers, *Geochemistry, *Hydrology, Sweden, Finland, Bothnian Bay.

The 87Sr/86Sr ratio in 53 water samples were analyzed, 26 from streams in Sweden, 22 from streams in Finland and 5 from the Bothnian Bay itself. The brackish seawater of the bay had the isotope ratio 0.7095, while the streamwater samples varied from 0.7177 to 0.7366. The weighted average isotope ratio with respect to discharges was 0.7313, this high ratio reflecting the dominance of granitic Proterozoic rocks in the region. For streams with an average discharge between 1-40 cu m/s the isotope ratio was within the interval 0.718-0.736, while those with discharges >150 cu m/s defined an interval of 0.728-0.735. The variations in isotope ratios are discussed with respect to bedrock geology of drainage basins, possible effects of seawater inundations and Postglacial uplift combined with the complex history of the Baltic Sea. (See also W88-02439) (Author's abstract)
W88-02440

PROBLEM OF 'RED WATERS': A NEW APPROACH TO ITS SOLUTION,
Water and Electricity Dept., Abu Dhabi (United Arab Emirates).
A. M. Shams El Din.
Desalination DSLNAH, Vol. 60, No. 1, p 75-88, September 1986. 1 fig, 2 tab, 27 ref.

Descriptors: *Red waters, *Water chemistry, *Water treatment, *Corrosion, Pipelines, Oxygen, Ions, Carbonates, Films, Chemical precipitation.

Red waters result from the attack of aggressive waters on the iron pipes of the distribution system. The corrosion of iron is presented in short and the importance of oxygen in sustaining the cathodic reaction is revealed. Natural or desalinated waters contain the elements of self-inhibition in the form of Ca(2+) and HCO3(-) ions. These, when carefully adjusted at the proper pH value, produce a compact, pore-free inhibiting film of CaCO3. The theoretical relations governing the precipitation of the film are outlined. The Langelier and similar indices, proposed and applied for the conditioning of potable waters, overlook the parts played by the metal and by oxygen in securing successful filming. Emphasis is laid on the reduction of oxygen which produces the OH(-) ions that trigger the deposition of CaCO3. The conditions allowing the successful formation of the film are defined as those where the fluxes of HCO3(-) and Ca(2+) are equal to or exceed that of the OH(-) ions. The new treatment is tested with the UMM Al Nar potable water. The type and sequence of precipitates contributing to film formation are arrived at from a consideration of the thermodynamics of the probable reactions. It is concluded that the film is heterogeneous in nature, formed of CaCO3, FeCO3, Fe(OH)3 and Mg(OH)2 in varying proportions. Factors interfering with film formation and/or stability are discussed briefly. (Author's abstract)
W88-02447

INFLUENCE OF ALKALINE PARTICULATES ON THE CHEMISTRY OF FOG WATER AT DELHI, NORTH INDIA,
Indian Inst. of Tropical Meteorology, Poona.
For primary bibliographic entry see Field 5A.
W88-02459

2L. Estuaries

BENTHIC RESOURCES ASSESSMENT TECHNIQUE, A METHOD FOR QUANTIFYING THE EFFECTS OF BENTHIC COMMUNITY CHANGES ON FISH RESOURCES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5C.
W88-01531

DREDGING AS A CLEANUP METHOD FOR AN INDUSTRIALIZED BAY,
Army Engineer District, Seattle, WA. Seattle District.
For primary bibliographic entry see Field 5G.
W88-01539

COASTAL AND INLET PROCESSES NUMERICAL MODELING SYSTEM,
Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 8B.
W88-01546

INTRODUCTION TO SAND CLOSURES AND RELATED COMPUTATION METHODS,
Svasek (B.V.) Rotterdam (Netherlands).
J. N. Svasek.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 292-304, 9 fig, 1 tab.

Descriptors: *Sand closures, *Mathematical models, *Estuaries, Mathematical studies, Sediment loss.

Estuaries may be enclosed using several techniques. In many cases, dredged sand is the most feasible source of material for the closure structure. The following points were addressed: (1) A description of sand closure and its advantages; (2) The processes involved; (3) How the processes can be simulated in mathematical models; and (4) The value of the computed results for the determination of the optimum execution method. In the field of sand closures a new terminology has developed. The major definitions are given here. A summary is also given of a number of sand closures, comparing the losses of sediment during the operations. (Computational methods for computing sand loses include (1) the RIUMOD - coefficient method, (2) the computer models LAGRA, UITZAK, EQBARI, and SLUITZAK. These methods permit the computation of the total loss by integration in time. After completion of the closure, the calculated and observed losses are in the same order of magnitude. (See also W88-01522) (Lantz-PTT)
W88-01553

INTERNATIONAL SYMPOSIUM ON THE MOST IMPORTANT UPWELLING AREAS OFF WESTERN AFRICA (CAPE BLANCO AND BENGUELA)(SIMPOSIO INTERNACIONAL SOBRE LAS AREAS DE AFLORAMIENTO MAS IMPORTANTES DEL OESTE AFRICANO (CABO BLANCO Y BENGUELA)).
Instituto de Investigaciones Pesqueras de Barcelona (Spain).
Volume 1, 1985. 586 p. Edited by C. Bas, R. Margalef, and P. Rubies.

Descriptors: *Oceanography, *Symposium, *Upwelling, *Cape Blanco, *Cape Benguela, Ocean circulation, Conferences, Ocean bottom, Primary productivity, Pelagic ecosystems, Coastal waters.

This symposium discusses the mechanisms and the physical and biological processes that relate to ocean upwelling at Capes Blanco and Benguela, off the West African coast. The three major section headings in this first volume are: (1) ocean dynamics, (2) primary productivity, and (3) pelagic ecosystems; with papers discussing topics from nutrient distributions and water temperature variability, to phytoplankton assemblages and the zoogeography of lanternfishes. (See W88-01616 thru W88-01652) (Lantz-PTT)
W88-01615

SOME ASPECTS OF PHYSICAL PROCESSES IN COASTAL UPWELLING,
Woods Hole Oceanographic Institution, MA.
K. H. Brink.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 5-14, 2 fig, 22 ref. NSF Grant No. OCE-8213968.

Descriptors: *Upwelling, *Coastal waters, *Ocean circulation, Wind-driven currents, Advection, Mixing, Hydrometeorology.

The considerable body of research in wind-driven coastal upwelling over the last decade makes it appropriate to try to evaluate the improvement of our understanding. In general, the recent results have led to a new appreciation of some general aspects of the problem which were not thoroughly explored in the earlier studies. A few of these aspects are reviewed. First, advances in the understanding of near-surface dynamics show how mixing and lateral advection determine the offshore scale and the length of time over which coastal upwelling affects the physical system. Second, alongshore variability in velocity and in the hydrographic field appear to be important in

all systems. This nonuniformity allows for important alongshore divergences in mass, heat and momentum. Finally, the upwelling process varies considerably over the meteorologically-set time scales of 2-10 days. Combined with the three dimensionality of the system, time dependence leads to highly irregular paths followed by individual parcels of upwelled water. The overall richness of observed upwelling phenomena may complicate interpretation of observations, but the traditional fundamental concepts remain remarkably useful as a qualitative basis of understanding. (See also W88-01615) (Author's abstract)
W88-01616

PHYSICAL AND CHEMICAL PARAMETERS IN THE BENGUELA AND CAPE BLANC REGIONS DURING FIRST AND SECOND R/V 'PROFESSOR SIEDLECKI' CRUISES, CONDUCTED IN NOV.-DEC. 1972 AND AUG.-SEPT. 1973,
Morski Inst. Rybacki, Gdynia (Poland).
A. Majewicz.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 15-24, 9 fig, 6 ref.

Descriptors: *Upwelling, *Ocean circulation, *Cape Benguela, *Cape Blanco, *Coastal waters, Water temperature, Salinity, Oxygen, Mixing, Ocean currents.

Fishing investigations were conducted on R/V 'Professor Siedlecki' in 1972 and 1973 in regions of Benguela Current and Cape Blanc; they were accompanied by basic oceanographic observations. Based on standard measurements such as temperature, salinity and oxygen, the center of upwelling was localized in the vicinity of Luderitz. The effect of this upwelling was observed in the entire coastal zone, between latitudes 22'5 S and 27'5 S. Upwelling was accompanied by weak horizontal currents which caused the opposite effect, i.e. downward movement of waters. In such a differentiated, three-dimensional circulation of water masses, no decrease of the oxygen contents was observed, as expected, in surface waters in the center of upwelling. The minimum oxygen content in bottom layers, in the south-western region of Africa, was about 0.24 ml/L. In the region of Cape Blanc, horizontal circulation predominated and the upwelling was very weak. (See also W88-01615) (Author's abstract)
W88-01617

NUTRIENT DISTRIBUTIONS IN THE CENTRAL WATER MASS FRONT NEAR CABO BLANCO, OCTOBER 1981,
Centro de Tecnologia Pesquera, Canarias (Spain).
O. Llinas, F. Fraga, and E. D. Barton.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 37-48, 11 fig, 5 ref.

Descriptors: *Upwelling, *Nutrients, *Ocean circulation, *Cape Blanco, *Central water mass, Phosphates, Nitrates, Mixing, Nutrients.

The distributions of nitrate and phosphate in the frontal zone between North and South Atlantic Central Water masses off Cape Blanco are described. The anomalies between observed nutrient values and those calculated from the proportion of each water mass entering the mixture are discussed. It is confirmed that the nucleus of North Atlantic Central Water which is found throughout the year between 20-21 N and 18-20 W around 150 m depth has an anomalously low nutrient concentration. (See also W88-01615) (Author's abstract)
W88-01618

STRUCTURE AND VARIABILITY OF THE CENTRAL WATER MASS FRONT OFF CABO BLANCO, OCTOBER 1981-APRIL 1982,
University Coll. of North Wales, Menai Bridge. Marine Science Labs.
E. D. Barton.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 49-61, 8 fig, 9 ref. Natural Environment Research Council Grant No. GR3/3522.

Descriptors: *Cape Blanco, *Coastal waters, *Salinity, *Ocean circulation, *Oceanography, *Water temperature, Central water mass, Mixing, Water currents, Conductivity.

Two cruises took place in October 1981 and April 1982 to investigate the boundary zone separating the North and South Atlantic Water Masses in the region 19-20 N. During both cruises, large scale conductivity-temperature-depth probe (CTD) surveys were carried out to locate the water mass boundary, finely spaced (1-2 km separation) hydrographic casts were made on sections through the boundary and time series were executed within the frontal zone. An array of three moorings, each carrying six current meters equipped with conductivity sensors, was placed close to the boundary zone during the first cruise and recovered during the second. The situation was quite similar during both cruises, with a tongue of South Atlantic Central Water extending northwards along the continental slope to about 22 N inshore of the North Atlantic Central Water (NACW). The water mass front was much stronger than previously observed. Horizontal changes of up to 0.001 in salinity occurred in distances of 10 km but compensating temperature gradients resulted in weak horizontal density differences. The front migrated across the mooring array about 30 days after deployment with a detectable lag between moorings, allowing a comparison of the associated hydrographic and flow fields. During the second cruise, an 80 km long, 50 m thick intrusion of NACW was found emanating from the front. Properties of the intrusion were consistent with an important role for double diffusive processes in its production and dissipation. (See also W88-01615) (Author's abstract)
W88-01619

MODELS OF COASTAL UPWELLING DRIVEN BY JOINT-1 AND AUFTRIEB-77 DATA,
University of East Anglia, Norwich (England). School of Mathematics and Physics.
J. A. Johnson.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 63-70, 4 fig, 5 ref.

Descriptors: *Ocean circulation, *Upwelling, *Coastal waters, *JOINT-1, *AUFTRIEB-77, *Model studies, Wind-driven currents, Data interpretation, Mauritania, Water temperature.

The wind stress time series measured during the JOINT-1 cruises off North West Africa are used to drive models of the coastal current along the North West African continental shelf. The models include the effects of shelf topography, coastline orientation, stratification and variability. Wind data from the AUFTRIEB-77 experiment between 17 N and 19 N off Mauritania are also used. The output from the models is compared with the Joint-1 and AUFTRIEB-77 current and temperature data. The orientation of the coastline is important and the effects caused by offshore variation in the wind field are significant. (See also W88-01615) (Author's abstract)
W88-01620

SOME EFFECTS OF LONGSHORE BOTTOM VARIABILITY ON NW AFRICAN UPWELLING DYNAMICS (ALGUNOS EFECTOS DE LA INFLUENCIA DE LA VARIACION DE PROFUNDIDAD DE COSTA Y FONDO EN SENTIDO N-S SOBRE LA DINAMICA DEL AFLORAMIENTO DEL NO DE AFRICA),
Centro de Calculo Electronico, Madrid (Spain).
A. Onoro, J. Font, and J. R. Pascual.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 71-77, 4 fig, 12 ref.

Descriptors: *Upwelling, *Ocean circulation, *Ocean bottom, *Model studies, *Cape Bojador, Wind currents, Water currents.

A simplified three-dimensional model of coastal upwelling circulation off Cape Bojador (NW Africa) assumes that steady state, cross-shelf velocity has a baroclinic component due to wind drag. A barotropic component provides the flux necessary to maintain a steady sea level. Longshore velocity is only baroclinic. The gradual longshore bottom rise produces a widening of the upwelling area as well as an attenuation of its intensity. Upwelled waters reach the continental shelf mainly on the northern side of the modelled region. (See also W88-01615) (Author's abstract)
W88-01621

VARIABILITY OF THE TEMPERATURE FIELD OFF THE NORTH-WESTERN COAST OF AFRICA,
Akademiya Nauk URSR, Sevastopol. Marine Hydrophysics Inst.
N. P. Bulgakov, A. B. Polonsky, Y. I. Popov, Y. V. Artamonov, and V. P. Nikiforova.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 79-92, 7 fig, 15 ref.

Descriptors: *Water temperature, *Upwelling, *Temperature gradient, *Ocean circulation, Africa, Seasonal variation, Thermocline, Coastal waters.

Variability of the vertical thermal structure of water and surface temperature is analyzed on the basis of two hydrological sets of data and en route observations of ocean surface temperature in the Tropical and Subtropical Atlantic. A specific role is shown of upwelling zones off the north-western coast of Africa in forming space-time variability of the temperature field in the low-frequency spectral region. Two regions in the upwelling zone which are qualitatively different from the viewpoint of seasonal variations in the temperature field of surface and subsurface layers are noted. In addition, a characteristic of interannual variability of surface temperature is given. (See also W88-01615) (Author's abstract)
W88-01622

ABOUT INTER-ANNUAL COASTAL UPWELLING VARIATIONS OFF NW-AFRICA WITH REFERENCE TO CHANGES OF 'SOUTHERN OSCILLATION',
Akademie der Wissenschaften der DDR, Rostock-Warnemuende. Inst. fuer Meereskunde.
N. Michelchen.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 93-100, 2 fig, 21 ref.

Descriptors: *Upwelling, *Coastal waters, *Southern Oscillation, *Water temperature, *Gulf of Guinea, Seasonal variation, Ocean circulation.

From the viewpoint of teleconnection between inter-annual variations of meteorological and oceanological anomalies in different tropical areas around the world caused by the steering mechanism of the 'Southern Oscillation', several time series of the sea surface temperature (SST) are analyzed from selected coastal stations in W. Africa over a time range of at least twenty years. The inter-annual response of monthly SST-anomalies (SSTA) off NW. Africa and along the northern coast of the Gulf of Guinea is compared with the corresponding response of the Southern Oscillation Index (SOI) as a well known indicator for the intensity of the 'Southern Oscillation'. One can find the following indications of this: (1) The inter-annual variations of SSTA are contrarily observed off NW Africa with respect to their sign as the corresponding anomalies along the northern coast of the Gulf of Guinea; (2) An accumulation of negative SSTA off NW Africa is frequently established in such situations which are designated by a decreasing SOI. There inter-annual response of

coastal waters off NW Africa and along the northern coast of Gulf of Guinea on the variability of the 'Southern Oscillation' may be a key question for the long-time planning of fishery-activities by the NW African countries. (See also W88-01615) (Author's abstract)
W88-01623

DIAGNOSTIC CASE STUDY OF MESO-SCALE UPWELLINGS WITHIN A LAYER NEAR THE SEA SURFACE OFF CAP BLANC IN SUMMER 1972,
Akademie der Wissenschaften der DDR, Rostock-Warnemuende. Inst. fuer Meereskunde.
E. Hagen, and A. M. Gurina.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 101-117, 7 fig, 17 ref.

Descriptors: *Upwelling, *Cape Blanco, *Coastal waters, *Case studies, Topography, Advection, Surface waters, Vorticity, Ocean circulation, Water currents, Phosphates, Oxygen, Nutrients.

Observed winds and densities were used for the calculation of currents by a nonlinear diagnostic model in a typical upwelling region off NW Africa, between the latitudes of 18 N and 22 N and from the longitudes of 17 30' W up to 19 30' W. Spatial current structures and the estimated relative vorticities were compared with the observed distribution of phosphate and oxygen. The relative vorticity at the sea surface is decomposed into a wind induced part and into a geostrophic part in order to distinguish local variation of causes of Rossby numbers Strong horizontal gradients of bottom topography produce locally fixed upwellings with Rossby numbers of 0 (0.1) where nonlinear processes enter the dynamics of motion. By these effects a further offshore upwelling is explained near the position of 21 N 19 20' W and a nearshore upwelling center between 18 /19 N, 17/ 18 W. It is concluded that the action of the topographic beta-effect on the alongshore flow (expressed by the alongshore advection of the relative vorticity) plays an important role for the production of meso-scale upwelling structures because the potential vorticity is not locally conserved. (See also W88-01615) (Author's abstract)
W88-01624

SEASONAL TRENDS IN THE LONGSHORE DISTRIBUTION OF SURFACE TEMPERATURES OFF SOUTHWESTERN AFRICA 18-34 S, AND THEIR RELATION TO SUBSURFACE CONDITIONS AND CURRENTS IN THE AREA 21-24 S,
Sea Fisheries Research Inst., Cape Town (South Africa).
A. J. Boyd, and J. J. Agenbag.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 119-148, 15 fig, 1 tab, 24 ref.

Descriptors: *Seasonal variation, *Coastal waters, *Water temperature, *Ocean circulation, Water currents, Upwelling, Thermocline, Salinity, Mixing, Continental shelf.

Seasonal averages of surface temperature are presented for the sea area 20-160 nautical miles offshore between 18 and 34 S off southwestern Africa, based on data received from shipping during 1968-1980. These averages show that an area of water cooler than 16 C extends along the whole coast between 18 and 34 S up to 140 mi offshore in winter and spring. In summer and autumn, this area contracts, and apart from cooler upwelled water within 20 mi of the coast, water cooler than 16 C only occurs between Walvis Bay (23 S) and Cape Town (34 S), to a maximum of 60 mi offshore. Strong longshore temperature gradients at 20 mi offshore occur south of St Helena Bay and Walvis Bay in all four seasons, with the coolest water occurring between these two sites. Smaller gradients are also found north of the Orange River and off Cape Frio. These features can be related to bottom topography, coastline orientation and the presence of advected water masses. Similar gradients are found at 60 mi offshore, but at 160 mi offshore little latitudinal temperature variation occurs between 34 and 20 S. The temperature trends based on shipping data agree with results from scientific cruises, but in addition the latter show a local surface temperature maximum at 22 S. Comparison is made with subsurface conditions in the region 21-24 S and the influence of solar heating of the upper 20 m can be seen from November to February, but from February to April a temperature rise occurs subsurface at 100 m depth as well. This temperature increase is associated with the occurrence of higher salinity conditions which last to May, but because a decrease in density is not encountered a reduction in upwelling is not indicated so much as is upwelling of water from a more northerly origin. Measurements of currents at a depth of 10 m and 25 mi offshore at 21 and 24 S show a dominant NW component of up to 40 cm/sec, which is most developed during southerly winds, with no apparent seasonal dependence. A southward flow which appears to be responsible for the higher salinity conditions between March and May, is deduced generally to occur below a wind driven upper layer and/or not at the current measuring sites just inside the edge of the continental shelf. (See also W88-01615) (Author's abstract)
W88-01625

WIND SHEAR AND UPWELLING ALONG THE SW TIP OF AFRICA,
Electricity Supply Commission, Johannesburg (South Africa).
M. R. Jury.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 149-159, 7 fig.

Descriptors: *Upwelling, *Wind-driven currents, *Ocean circulation, *Coastal waters, *Shear, *Cape Benguela, Case studies, Topography, Temporal distribution, Spatial distribution, Water currents, Vorticity, Water temperature.

Along the SW Coast of South Africa (30-35 S, 17-20 E) topographic irregularities shear the summer wind field giving rise to an alongshore variability in coastal upwelling. Low level winds accelerate over portions of the southern Benguela Current through deflections forced by three pronounced capes, two with mountain ridges exceeding 1000 m. Using aerial survey data, a case study was selected to describe the mesoscale spatial and temporal variability of the summer wind field. Case study results contrast the characteristics of deep and shallow equatorwards wind flow. During + or - 2 km deep SE winds, a homogeneous and coast-parallel flow was observed while in shallow flow of less than 1 km, mesoscale variations and mountain wind wakes were found. Vertical wind shear was found to play a controlling role in the interaction of topography and wind. Field results indicate that vertical shears of -2(0.01)/sec produce horizontal wind vorticities of -6(0.0001)/sec and alongshore sea surface temperature gradients of 1 C/km, a characteristic of mesoscale coastal winds and upwelling in the southern Benguela Current. (See also W88-01615) (Author's abstract)
W88-01626

MESO-SCALE UPWELLINGS OFF NAMIBIAN COAST,
Akademie der Wissenschaften der DDR, Rostock-Warnemuende. Inst. fuer Meereskunde.
E. Hagen.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 161-179, 10 fig, 1 tab, 5 ref.

Descriptors: *Coastal waters, *Upwelling, *Continental shelf, *Ocean circulation, Water currents, Wind-driven currents, Mass field, Mathematical studies, Topography.

The across shore variations in time of the mass field, which are caused by barotropic continental shelf waves owing to the exponential approximation of a typical shelf profile, are compared with the across shore variations in time in empirical orthogonal functions of the observed winds and the baroclinic mass field for the zone between 30 km and 170 km offshore at a latitude of 20.5 S in the austral spring of 1979. It is assumed that the energy-rich barotropic continental shelf waves over the shelf occasionally impress their space-time structures upon the dynamics of local baroclinic processes. By this viewpoint, it is shown that in the 100 km coastal zone the local across shore variations in time in the structure of the observed mass field can be adequately explained in terms of the linear theory of continental shelf waves. In this coastal zone the current and mass field respond hydrostatically to variations in the along shore component of the local wind, the across shore structure of the mass field being predominantly linearly dependent upon the linear across shore dependence of the along shore wind component with a period of 5.6 days. The existence of an internal topographical Rossby wave with a period of about 13 days seems probable seaward of this zone. (See also W88-01615) (Author's abstract)
W88-01627

ANALYSIS OF THE RECENT ENVIRONMENTAL PERTURBATION IN THE SOUTH EAST ATLANTIC AND LATEST FINDINGS ON ITS IMPACT ON FISHERIES OF THE SOUTHERN BENGUELA REGION (UN ANALISIS DE LAS RECIENTES PERTURBACIONES EN EL ATLANTICO SUDESTE Y LOS ULTIMOS HALLAZGOS SOBRE SU IMPACTO EN LA PESQUERIA DE LA REGION SUR DE BENGUELA),
Sea Fisheries Research Inst., Cape Town (South Africa).
L. V. Shannon, G. B. Brundrit, R. J. M. Crawford, A. I. L. Payne, and P. A. Shelton.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 181-200, 8 fig, 33 ref.

Descriptors: *Fisheries, *Coastal waters, *Cape Benguela, *Ocean circulation*Environmental effects, Oceanography, Meteorology, Water temperature, Upwelling, Physalia, Red tides, Benthic environment, Ecological distribution.

There is fairly conclusive evidence that the summer of 1982/83 was oceanographically anomalous in the southern Benguela region south of 32 S. The higher incidence of cold fronts passing over the south western Cape, the positions of the atmospheric pressure systems and Subtropical Convergence zone, the altered distribution of sea surface temperature, the reduction in south-easterly winds and consequently upwelling, the prevalence of Physalia, red tides and small flagellates, changes in the distribution of intertidal organisms, and the local breeding failure of some sea birds, all point to a perturbed situation. What is also significant is that the warm event in the southern Benguela coincided with a warm event (El Nino) in the tropical Pacific, indicating an environmental perturbation on a global rather than a local scale. The 1982/83 event appears to have adversely affected the South African purse-seine fishery, the catch per unit effort being the lowest of the twenty-year period for which there are records of effort. The anchovy in particular did not seem to be readily available during the first three months of 1983. In contrast, there is no indication that the warm event has adversely affected hake. (See also W88-01615) (Author's abstract)
W88-01628

WATER EXCHANGE BETWEEN THE RED SEA AND GULF OF ADEN,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. M. Osman.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 205-212, 1 fig, 4 tab, 13 ref.

Descriptors: *Red Sea, *Gulf of Aden, *Water exchange, Water supply, Model studies, Seasonal variation, Upwelling, Ocean circulation, Salinity.

The Red Sea is a semi-isolated body of water having no tributaries and negligible rainfall. Due to the arid climate of the area, evaporation from its surface is exceedingly high. The only significant water supply is from the Gulf of Aden. Accordingly, during any month the water budget of the sea is determined mainly by the water exchange through the Strait of Bab-El-Mandeb, the amount of evaporation and month-to-month sea level variations. These facts are incorporated in a simplified model to estimate monthly net water volume transports. The obtained values are combined with monthly surface transports to determine monthly and annual transports of the inflowing and outflowing waters. The achieved results for the annual volumes of the inflowing and outflowing water are in good agreement with those obtained from Knudsen's Hydrographical Theorem. The examination of water and salt interchanges supports the validity of the obtained results. (See also W88-01615) (Author's abstract)
W88-01629

RELATIONSHIP BETWEEN THE DECREASE IN SOLAR CONSTANT AND THE NORTH-SOUTH FLOW IN THE CALIFORNIA CURRENT,
Instituto de Investigacones Pesqueras de Vigo (Spain).
M. G. Larraneta, and A. Vazquez.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 213-221, 4 fig, 1 tab, 13 ref.

Descriptors: *Water currents, *Ocean circulation, *Solar radiation, *California current, Solar energy, Energy flux, Seasonal variation, Oceanography.

The following hypothesis is discussed: Variations of the oceanic currents depend mainly on these two factors: (1) the variation of the solar energy flux; and (2) the energy dissipated from Earth's variable rotation. In oceanic currents having an E-W direction the main factor will be polar motion, but in currents N-S this factor will be variations of the solar energy flux. Previously the authors had studied the effect of polar motion in marine ecosystems of the North Atlantic Ocean, where currents have a W-E main direction. An experiment was conducted to test if in N-S currents the variation of the solar energy flux acts as a perceptible factor. Percent of decrease in solar constant and coefficient of a variation for the first Empirical Orthogonal Function in the California Current, as an example of N-S current, have been used. Relationship between these two factors appears to be significant, and the time lag between changes of the solar energy flux and response of the current flow seems to be about 3-9 months. A seasonal variation of the velocity of the Kuroshio seems to confirm this solar energy role in oceanic currents. (See also W88-01615) (Author's abstract)
W88-01630

PRIMARY PRODUCTION IN UPWELLING AREAS. ENERGY, GLOBAL ECOLOGY AND RESOURCES,
Barcelona Univ. (Spain). Dept. de Ecologia.
R. Margalef.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 225-232, 14 ref.

Descriptors: *Ocean circulation, *Primary productivity, *Upwelling, *Energy, Kinetic energy, Ecosystems, Oxygen, Nitrogen, Nutrient cycling, Phosphates, Food chain, Stress.

Primary production is dependent on supporting exosomatic energy. The work done by exosomatic energy that is effective in promoting primary production is unevenly distributed. From the point of view of biological production, ocean kinetic energy is particularly effective in upwelling systems. The organization of the machine that enhances primary production is reflected in its spatial structure and in its fluctuations. Upwelling ecosystems are under stress which accelerates internal cycling. A fraction of the recirculating elements be discharged at the boundaries: oxygen and nitrogen to the atmosphere, phosphate and organic carbon to the sediment. The spectrum of change in the upwelling ecosystems is conducive to short food chains, relatively low efficiency, and positive selection of species that are also able to survive important exploitation by man. This reason may be as important or more important than the high productivity in any appreciation of the value of the resources provided by the upwelling areas. (See also W88-01615) (Author's abstract)
W88-01631

PRIMARY PRODUCTION IN THE CAP BLANC REGION,
University of Southern California, Los Angeles. Allan Hancock Foundation.
R. C. Dugdale, and F. P. Wilkerson.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 233-243, 3 fig, 21 ref. NSF Grant Nos. OCE 765004 and OCE 7727006.

Descriptors: *Primary productivity, *Cape Blanco, *Upwelling, *Ocean circulation, *Phytoplankton, Ecosystems, Model studies, Carbon, Nitrogen, Nutrient cycling, Nutrients, Food chain, Wind, Stress.

Estimation of integrated seasonal or annual primary production in an upwelling area is made difficult by the short time and space scales of variability. However, an understanding of the physical and chemical processes that control phytoplankton processes in a specific upwelling area may be the most practical approach to understanding the position of the area in the hierarchy of major upwelling systems. Intensive studies of some of the major upwelling regions have revealed basic patterns of physical, chemical and biological processes. Results from studies in Peru have been synthesized into an idealized steady-state conceptual model of the upwelling primary production cycle. An adaptive 'shift-up' phase, with increasing carbon and nitrogen specific uptake rates, occurs following upwelling of a phytoplankton seed population with nutrient rich water to high ambient irradiance. The shift-up phase is followed by a shift-down phase as nutrients decline and typical symptoms of nutrient limitation appear. The manner in which the cycle proceeds in a given area or during a specific environmental event is modulated by physical and chemical processes, with high wind-stress and the resulting turbulence reducing the rate of increases during the shift-up phase, and the initial nutrient concentration limiting both the length of time the shift-up phase continues and the total production resulting from the cycle. Both wind-stress and nutrient conditions appear to be important factors in reducing the Cape Blanc primary production values below those observed in Peru. (See also W88-01615) (Author's abstract)
W88-01632

NITROGEN FIXATION BY TRICHODESMIUM THIEBAUTII IN THE UPWELLING REGION OFF NORTHWEST AFRICA,
Instituto de Investigaciones Pesqueras de Barcelona (Spain).
F. Vallespinos.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 245-251, 2 fig, 2 tab, 17 ref.

Descriptors: *Nitrogen fixation, *Trichodesmium thiebautii, *Upwelling, Ecosystems, Biomass, Water mass, Algae, Chlorophyll a, Seasonal variation.

Trichodesmium thiebautii biomass in the upwelling region off NW Africa and relationships with the water masses were studied during the cruise ATLOR VII carried out in November 1975. The acetylene reduction technique was used to measure the N2 fixation. In autumn, this algae is predominantly distributed in the area occupied by South Surface water, very poor in nutrient contents. Average N2 fixation for seven stations was 0.45 microgram N/microgram chlorophyll a/h, and the average chlorophyll a and protein contents of the colonies was 0.035 microgram and 0.77 microgram respectively. In the area surveyed, T. thiebautii is most abundant from August to November, while it is absent during the spring. In automn, nutrients are absent at the surface (layer 35 m thick). It is concluded that T. thiebautii assimilates N at a fast rate and it is imferred that its growth and metabolism are also fast. Due to the temporal fluctuations of the surface layer populations, the blooms are presumably formed by rapid growth. (See also W88-01615) (Lantz-PTT)
W88-01633

COASTAL-ZONE-COLOR-SCANNER (CZCS) IMAGERY FROM NORTHWEST AFRICAN UPWELLING,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 7B.
W88-01634

PRELIMINARY CARBON BUDGET OF THE SOUTHERN BENGUELA PELAGIC ECOSYSTEM,
Cape Town Univ. (South Africa). Dept. of Applied Mathematics.
M. O. Bergh, J. G. Field, and L. V. Shannon.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 281-304, 6 fig, 8 tab, 51 ref.

Descriptors: *Cape Benguela, *Ecosystems, *Carbon budget, *Upwelling, Ocean circulation, Energy, Primary productivity, Chlorophyll, Oxygen, Carbon radioisotopes, Biomass, Fish, Food chain, Mammals.

A study was conducted to assess the standing stocks of the main components of the southern Benguela ecosystem, their productivity and the flows of energy or carbon along the main pathways of the food web. A matrix of trophic interactions between the main components of the pelagic ecosystem was constructed from information obtained by interviewing fisheries scientists and from published data. Primary production was estimated from a combination of satellite ocean color measurements, shipboard chlorophyll measurements, and C-14 uptake and oxygen production experiments. Secondary production was estimated using biomass data and turnover rates or predator consumption requirements. The daily carbon requirements of zooplankton, planktivorous and predatory fish, birds, squid and mammals were estimated to compile a tentative input-output matrix for the main components of the system. The budget indicates that predatory fish are by far the most important predators on small shoal fish followed by squid, seals, sea birds, Bryde's whales and dolphins. The preliminary budget suggests that some 75% of the primary production is lost from the euphotic surface waters as detritus annually. The problems associated with accounting for predation on zooplankton are discussed. Demersal hake stocks are the most valuable resource and the most important carnivores on midwater fish and squid. Ecological interactions between small shoal fish, squid and hake are discussed, suggesting that changes in exploitation patterns may have unpredictable effects on the ecosystem. (See also W88-01615) (Author's abstract)
W88-01635

DISTRIBUTION AND CYCLING OF NUTRIENTS AT FOUR SITES IN THE BENGUELA SYSTEM,
Sea Fisheries Research Inst., Cape Town (South Africa).
G. W. Bailey.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 305-317, 8 fig, 1 tab, 25 ref.

Descriptors: *Nutrient cycling, *Cape Benguela, *Nutrient distribution, *Upwelling, Nutrient distri-

bution, Phytoplankton, Ocean circulation, Primary productivity.

Comparisons are made between the distribution of nutrients in two different areas in the Southern Benguela system and two in the Northern Benguela system. The regions in which these areas are found lie between 32 and 35 S in the south and 24 and 28 S in the north. Both regions are characterized by an area of strong upwelling in the southern half and an area of decreased upwelling activity towards the north. Although upwelling of nutrient-rich South Atlantic Central Water is of major importance to the phytoplankton population, the more stable conditions in the northern part of each region favor higher levels of primary production, greater sedimentation of particulate organic matter and greater local recycling of nutrients. (See also W88-01615) (Author's abstract)
W88-01636

PHYTOPLANKTON DISTRIBUTION AND DYNAMICS IN THE SOUTHERN BENGUELA CURRENT,
Sea Fisheries Research Inst., Cape Town (South Africa).
P. C. Brown, and L. Hutchings.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 319-344, 12 fig, 2 tab, 64 ref.

Descriptors: *Cape Benguela, *Phytoplankton, *Ecological distribution, Chlorophyll a, Species diversity, Diatoms, Upwelling, Nitrates, Nutrient availability.

Developments in research into the ecology of phytoplankton in the southern Benguela region are reviewed. Species identification, cell counts and chlorophyll a distribution from shipboard measurement give some indication of the overall spatial and seasonal distribution of phytoplankton. This is followed by some results of more intensive surveys, which include estimates of primary production, both at fixed inshore stations and on six cruises when the ship followed drogues placed in upwelled water. The drogue studies show that a short but intense burst of diatom growth strips most of the nitrate from the newly upwelled water within five to eight days, during which time the water mass stays close to the shore. (See also W88-01615) (Author's abstract)
W88-01637

DEVELOPMENT OF PHYTOPLANKTON COMMUNITIES IN TERMS OF THEIR PARTICLE SIZE FREQUENCY DISTRIBUTION, IN NEWLY UPWELLED WATERS OF THE SOUTHERN BENGUELA CURRENT,
Sea Fisheries Research Inst., Cape Town (South Africa).
E. T. Olivieri, L. Hutchings, P. C. Brown, and R. G. Barlow.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 345-371, 14 fig, 1 tab, 51 ref.

Descriptors: *Phytoplankton, *Upwelling, *Particle size, *Ecological distribution, *Cape Benguela, *Frequency distribution, Biomass, Ecosystems, Species diversity, Wind-driven currents, Ocean circulation, Mixing.

The growth and decay of three phytoplankton communities are described in newly upwelled waters of the southern Benguela Current. The communities varied in their development and in their diversity and species dominance. Their particle size spectra also differed in terms of total biomass and size range of the particle volume peaks. Changes in the species composition and growth were attributed to short-term wind variations by allowing upwelled developing waters to mix with different neighboring water bodies. (See also W88-01615) (Author's abstract)
W88-01638

SOME WAYS OF INCREASING WATER BIOLOGICAL PRODUCTIVITY,
All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
B. P. Pshenichnyj, and N. V. Vershinskij.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 373-375, 4 ref.

Descriptors: *Productivity, *Upwelling, *Black Sea, Energy, Pumps, Water temperature, Wind-driven currents, Feasibility studies.

Artificially generated upwellings are an option to increase the natural productivity of the oceans. Several designs are known to have been made in applying this idea, using different methods to supply the necessary energy (pumps, deep water heating, wind and wave energy, tide-generating power, etc.). A series of experiments, using sea waves energy, conducted in the Black Sea are described, the results showing the feasibility of this idea. The potential production value using artificial upwelling in the Black Sea could reach 1.2 gmC/cu m, which is at least an order of magnitude higher than that observed in the surface layer during the study period. It is suggested that the efforts of several states interested in the conservation and increase of fish resources in a particular region could be pooled and that research work could be sponsored by international fisheries and food organizations. (See also W88-01615) (Lantz-PTT)
W88-01639

PHYTOPLANKTON ASSEMBLAGES IN COASTAL UPWELLING AREAS,
Instituto de Investigaciones Pesqueras de Barcelona (Spain).
M. Estrada, and D. Blasco.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 379-402, 8 fig, 1 tab, 70 ref. NSF Grant Nos. OCE83-09410 and OCE821-5225.

Descriptors: *Upwelling, *Phytoplankton, *Coastal waters, *Ecosystems, Ecological distribution, Wind-driven currents, Ocean circulation, Mixing.

Upwelling systems are highly dynamic and present important variability at various space and time scales. However, the basic physical structure of the main coastal upwelling areas is comparable and the available phytoplankton studies suggest that the distribution of phytoplankton in these areas presents many common features. During periods of favorable wind, the upwelling ecosystems consist of a core of turbulent, cold, nutrient-rich water surrounded by areas with progressively higher stability. The whole structure expands or contracts according to the intensity of the physical forcing (winds, waves). Differences in the physical environment related to temporal patterns of intensification and relaxation of upwelling, water circulation and the contribution of the different water masses are reflected in variations of the phytoplankton composition. Studies carried out mainly off NW Africa and Peru have suggested that the phytoplankton of a coastal upwelling region can be described as a series of assemblages, which, from the point of view of their species composition, can be ordained along an axis relating phytoplankton life-forms to decaying turbulence and nutrient availability. (See also W88-01615) (Author's abstract)
W88-01640

IDENTIFIED PHYTOPLANKTONIC SPECIES IN SHALLOW WATERS OFF EASTERN CANARY ISLANDS (ESPECIES FITOPLANCTONICAS IDENTIFICADAS EN AGUAS LITORALES DE LAS ISLAS CANARIAS ORIENTALES),
Centro de Tecnologia Pesquera, Canarias (Spain).
A. Ojeda.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 403-415, 3 fig, 18 ref.

Descriptors: *Phytoplankton, *Taxonomy, *Coastal waters, *Canary Islands, Species distribution.

Two hundred and twenty-one species have been identified in the inshore waters around the eastern Canary Islands. A high percentage of them have been cited for the Mediterranean Sea (31%), and 25% for the North Atlantic. Twenty-two percent are widespread species. A small number of them (4%) have been cited for the NW Pacific. The majority of species (38%) either seldom appear in the samples or they are not very abundant (34%). Only 4% are considered to be very abundant during the season in which they show their peaks in abundance. (See also W88-01615) (Author's abstract)
W88-01641

EFFECTS OF THE 'EL NINO' 1982-83 ON THE PHYTOPLANKTON OFF PERU (EFECTOS DEL FENOMENO 'EL NINO' 1982-83 SOBRE EL FITOPLANCTON DE LA COSTA PERUANA),
Instituto del Mar del Peru, Callao.
B. Rojas de Mendiola, O. Gomez, and N. Ochoa.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 417-433, 4 fig, 1 tab, 5 ref.

Descriptors: *El Nino, *Phytoplankton, *Peru, *Ecological distribution, *Ocean circulation, Water temperature, Biomass, Species diversity.

The 'El Nino' phenomenon, an intrusion of warm water masses into the Peruvian coast, breaks the equilibrium between the different components of the ecosystem in this region affecting the phytoplankton. Changes in phytoplankton communities, their distribution and abundance are directly related to the intensity of the El Nino. The plankton biomass of Peru is usually high, with an average of 5 ml/cu m within 60 mi from the coast. Great reductions of this value are directly related to the El Nino intensity. Thus, during the El Nino 1972-73, which was considered to be a Big Nino, the average was 0.3 ml/cu m, while during the El Nino 1982-83 this value fell to less than 0.1 ml/cu m, showing its negative impact on the phytoplankton. The lowest values, which are normally obtained beyond the 60 mi distance offshore, are found very close inshore during El Nino events. When the El Nino 1982-83 reached its peak (April-May), these very low values covered all Peruvian coastal waters. The phytoplankton principally composed of diatoms, containing a small proportion of dinoflagellates, is normally distributed along the coast, showing peaks of abundance at the borders of the upwelling areas; outside the 60 miles offshore line, the phytoplankton is mainly made up of dinoflagellates. During El Nino events this distribution is totally different. The warm waters dinoflagellates come near the coast to 10 miles or less from the shore, while the Peruvian Current-typical diatoms are either relegated to very small and nearshore areas, or are replaced by large diatoms characteristic of the invading water masses. (See also W88-01615) (Lantz-PTT)
W88-01642

PARTICULATE CARBON AND NITROGEN AND PLANKTON BIOMASS IN OLIGOTROPHIC AND UPWELLING SYSTEMS,
Instituto de Investigaciones Pesqueras de Barcelona (Spain).
M. Alcaraz, M. Estrada, J. Flos, and F. Fraga.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 435-448, 6 fig, 5 tab, 21 ref.

Descriptors: *Carbon, *Nitrogen, *Plankton, *Biomass, *Upwelling, Organic carbon, Zooplankton, Chlorophyll a, Ecosystems, Nitrogen compounds.

Quantitative relationships between particulate organic carbon and nitrogen (total: TOC, TON; mesozooplankton: ZOC, ZON), chlorophyll a, and C fixation are often used to describe some functional properties of marine ecosystems since they reflect the contribution of living plankton to particulate matter concentrations. Following this approach, data from three cruises, one in the NW African

upwelling region (ATLOR-VII, November 1975), and two in the Western Mediterranean (MEDITERANEO-I, October-November 1976, and PEP-82, July 1982), have been analyzed. The ATLOR-VII samples have been divided into two groups, 'poor' and 'rich', according to their chlorophyll a content < 1.5 or > or = 1.5 mg/cu m. TOC and TON concentrations in the 'poor' samples were of the same order as the average values in the Mediterranean, while in the 'rich' samples, TOC and TON concentrations were approximately twice those in the Mediterranean. ZOC and ZON values in the Mediterranean ranged from 1/4 to 1/2 those in the NW African upwelling area. (See also W88-01615) (Author's abstract)
W88-01643

ZOOPLANKTON POPULATIONS FROM THE WEST COAST OF AFRICA (SOBRE LAS POBLACIONES DEL ZOOPLANCTON DEL ATLANTICO AFRICANO),
Instituto de Investigaciones Pesqueras de Barcelona (Spain).
F. Vives.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 449-470, 3 fig, 66 ref.

Descriptors: *Zooplankton, *Coastal waters, *Ecosystems, *Upwelling, *Cape Benguela, *Gulf of Guinea, *Cape Blanco, Taxonomy, Biomass.

Studies on the most important zooplankton taxa carried out in both major upwelling areas of the Atlantic coast of Africa (Cape Blanco and Benguela) are briefly reviewed. Comments on some research works conducted in the Gulf of Guinea region are also made. Early investigations dealt mainly with systematics, while during the recent decades the attention centered on biomass, physiology, and various ecological aspects of plankton. These studies permitted comparisons between ecosystems under practically continuous upwelling conditions, as in the Cape Blanco area, and under only short periods of upwelling, as in the Gulf of Guinea. (See also W88-01615) (Author's abstract)
W88-01644

ZOOPLANKTON BIOMASS IN UPWELLING REGIONS OFF NORTHWEST AND SOUTHWEST AFRICA,
Instituto de Investigaciones Pesqueras de Barcelona (Spain).
M. P. Olivar, P. Rubies, and J. Salat.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 471-477, 6 fig, 8 ref.

Descriptors: *Zooplankton, *Biomass, *Upwelling, Ocean circulation, Water temperature.

The amounts and distributions of zooplankton biomass were compared between two oceanographic cruises conducted in each one of the upwelling regions off the African coast during spring. In both cases, the samples came from oblique hauls made with a Bongo type engine fitted with 505 micrometer mesh size nets. The hydrographic features found during the cruises, especially the location of the upwelling centers, could explain the plankton biomass distribution obtained in each case. The comparison between both regions led to the following comments: (1) The southwest upwelling region showed better inherent conditions favoring plankton development, and the obtained values of biomass were noticeably higher; (2) The peaks of plankton abundance in the northwest region were found at a greater distance from the coast than in the southwest region; and (3) Lowest values of plankton biomass were found in areas with more stratified waters. (See also W88-01615) (Author's abstract)
W88-01645

PELAGIC CROSS-SHELF AND ALONGSHORE BOUNDARIES OF THE NORTH WEST AFRICAN UPWELLING REGION AND THEIR ANNUAL VARIABILITY IN TERMS OF ZOOPLANKTON BIOMASS,
Akademie der Wissenschaften der DDR, Rostock-Warnemuende. Inst. fuer Meereskunde.
L. Postel.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 479-487, 4 fig, 2 tab, 15 ref.

Descriptors: *Upwelling, *Ocean circulation, *Zooplankton, *Biomass, *Coastal waters, Pelagic zone, Water temperature, Seasonal variation.

The cross-shelf and alongshore extent of the biological effects of coastal upwelling is estimated on the basis of zooplankton biomass data for the pelagic zone off North West Africa. The definition of a characteristic biomass for the adjacent pelagic zone of the Tropical Central Atlantic is used as an aid. In the cross-shelf direction, the 'biological' effects of cold water upwelling can be discerned for several hundred kilometers, and off Cape Blanc (20 55' N) it therefore exceed the range of the 'physically' defined upwelling zone by a factor of 2.5-3.7. In the alongshore direction the 'physical' and 'biological' effects are both apparent over a distance exceeding 100 km. Alongshore seasonal variations are very probably of the same order as the meridional migration of cold water upwelling phenomena. In the cross-shelf direction, variations off Nouakchott (17 50' N) and Cape Vert (14 45 N) appear to be chiefly of seasonal character. (See also W88-01615) (Author's abstract)
W88-01646

HORIZONTAL AND VERTICAL DISTRIBUTION PATTERNS OF FISH LARVAE OFF NW AFRICA IN RELATION TO THE ENVIRONMENT,
Zoologisches Inst. und Museum, Hamburg (Germany, F.R.).
H. C. John.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 489-512, 8 fig, 5 tab, 52 ref.

Descriptors: *Ecological distribution, *Fish, *Larvae, *Cape Blanco, Seasonal variation, Water temperature, Upwelling, Ichthyoplankton, Species diversity.

Off Cape Blanco a stationary boundary between water masses persists throughout the year. Off Mauritania, however, there are significant seasonal changes in temperature. These changes seem to be reflected in differences in the species composition of ichthyoplankton. In winter larvae of temperate species prevail, in autumn the number of tropical species increases. During the winter of 1977, when strong upwelling was observed, the highest abundance of fish larvae was found along the continental slope. The maximum occurred in the upper 60 m of water above 16 C. The mean abundance was 285 larvae/sq m, while during autumn a mean of only 28 larvae/sq m was found. Species composition and abundance differed with depth. In surface waters (< 30 m) larvae of Belone, Bugilidae, Engraulis, Sardina, Gobiidae, and Sparidae postlarvae dominated, a more extended range being occupied by larvae of several myctophids, Merluccius, Trachurus, Microchirus and Sparidae. The maximum of the less abundant Glossanodon and Maurolicus larvae was between 60 and 90 m. The horizontal distribution of larvae could be interpreted fairly well on the basis of the current system and area of spawning of the adults. Larvae which live near the surface drifted preferentially towards the south and offshore, larvae with extended vertical range were at least partly carried also by deeper currents in the opposite direction. The vertical distribution of fish larvae off Mauritania may not readily be extended to other areas. The southward drift of the near-surface larvae may be an exception due to the strong upwelling in 1977 rather than a regular feature. (See also W88-01615) (Author's abstract)
W88-01647

DISTRIBUTION AND ABUNDANCE OF MYCTOPHID AND GONOSTOMATID LARVAE OFF NW AFRICA (DISTRIBUCION Y ABUNDANCIA DE LARVAS DE MICTOFIDOS Y GONOSTOMATIDOS EN EL NOROESTE DE AFRICA),
Instituto de Investigaciones Pesqueras de Barcelona (Spain).
A. Sabates, and P. Rubies.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 513-522, 5 fig, 2 tab, 4 ref.

Descriptors: *Ecological distribution, *Coastal waters, *Myctophids, *Gonostomatids, Phytoplankton, Seasonal variation, Upwelling.

Plankton samples were taken off NW Africa during two cruises, ATLOR V (April-May 1974) and ATLOR VI (October 1975). Three species belonging to the family Gonostomatidae and 14 species belonging to the family Myctophidae have been identified. The species were the same in both cruises, but their density was higher during the autumn cruise (ATLOR VI). This was coincident with the strength of the upwelling observed in the region during that season. The most abundant species was the Gonostomatid Maurolicus muelleri, while the greater specific diversity was shown by the family Myctophidae. The maximum density of larvae was found over the continental slope while in the central part of the area, between 24 45' N and 24 15' N, there was an absolute lack of larvae. (See also W88-01615) (Author's abstract)
W88-01648

INFLUENCE OF ENVIRONMENTAL FACTORS ON THE CAPE PELAGIC FISHERY,
Sea Fisheries Research Inst., Cape Town (South Africa).
L. Hutchings, and G. Nelson.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 523-540, 13 fig, 19 ref.

Descriptors: *Environmental effects, *Pelagic fisheries, *Ecological distribution, Fisheries, Plankton, Upwelling, Wind-driven currents, Larvae, Feeding.

The potential influence of environmental factors on recruitment and distribution of fish in the Cape Pelagic fishery is discussed. The fishery is dominated by the anchovy Engraulis capensis, and the pilchard Sardinops ocellata, which contribute about 80% of the 300-400,000 metric tons catches in the South-west Cape. The development of plankton populations in the regions of spawning, transport of eggs and first-feeding larvae, and recruiting juveniles are discussed in relation to wind, turbulence and upwelling. A simple time scale model of response times based on generation lengths suggested that wind anomalies had to persist for at least 3-4 months in order to affect pelagic fish recruitment; this has only occurred twice in the past 22 years, in 1965/66 and 1982/83, when upwelling winds decreased by about 30-40% from the mean. Recruitment has not altered drastically during the past 16-18 years, suggesting that either the fishery was under-exploited or that recruitment success is strongly buffered in this pulsing, variable area. (See also W88-01615) (Author's abstract)
W88-01649

ENVIRONMENTAL BASIN MODEL FOR WEST COAST PELAGIC FISH DISTRIBUTION,
Sea Fisheries Research Inst., Cape Town (South Africa).
R. A. Cruickshank, and A. J. Boyd.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 541-549, 8 fig, 14 ref.

Descriptors: *Pelagic fisheries, *Ecological distribution, *Model studies, *Cape Benguela, Water temperature, Pilchard, Anchovy, Seasonal variation, Shoals.

Surface temperatures at 20 miles offshore between Cape Town and Cape Frio were used to construct

an environmental basin model for pilchard and anchovy. Favorable temperatures were selected to correspond to areas of higher anchovy and pilchard concentrations off South West Africa in Summer and Winter as evidenced by fish shoal distributions. Deviations from these temperatures define the environmental basins. The resulting limits of fish shoal distributions agree with those found off South West Africa and the Cape. A small area favorable for occupation by anchovy is indicated to exist between the Orange River and Luderitz in both seasons but a major environmental barrier for pilchard is evident between 33 C and 24 S in the summer spawning season. Analysis of shoal depth frequency compared to temperatures confirms the preferred temperature range of 13-18 C. (See also W88-01615) (Author's abstract)
W88-01650

POPULATION GENETICS OF THE SOUTHERN AFRICAN PILCHARD, SARDINOPS OCELLATA, IN THE BENGUELA UPWELLING SYSTEM,
Sea Fisheries Research Inst., Cape Town (South Africa).
W. S. Grant.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 551-562, 2 fig, 3 tab, 32 ref.

Descriptors: *Pilchard, *Cape Benguela, *Upwelling, *Genetics, Geographic distribution, Fish populations.

Tag-recovery data suggest that southern African pilchards are subdivided into at least two stocks: a northern stock off Namibia and a southern stock off the west and south coasts of South Africa. The geographic distributions of inherited protein variants were used to measure the amount of genetic differentiation among 6 samples collected between 19 10' S and Algoa Bay (33 49' S, 26 08' E). The gene products of 30 protein-coding loci were identified where 8 (27%) loci showed Mendelian variation, but only 4 (13%) had common-allele frequencies less than 0.95, and hence were useful for testing hypotheses of geographic structure. A contingency-table analysis of allelic frequencies revealed no significant differences among the samples. The average Nei genetic distance between pairs of samples was 0.003 and was typical for genetic distances between populations of pelagic fishes having a large potential for gene flow between populations. The average heterozygosity was 0.032 and represented 99.3% of the total genetic variation. The remaining 0.7% of the genetic diversity was due to differences between populations. These results show that the Namibian and South African stocks are not genetically distinct. The observed amount of genetic differentiation between the stocks is compared to the predictions of the linear stepping-stone model of migration. (See also W88-01615) (Author's abstract)
W88-01651

ZOOGEOGRAPHY OF THE LANTERNFISHES (OSTEICHTHYES, MYCTOPHIDAE) OF SOUTHWEST AFRICA,
Instituto de Investigaciones Pesqueras de Barcelona (Spain).
P. Rubies.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 573-586, 3 fig, 4 tab, 26 ref.

Descriptors: *Lanternfish, *Ecological distribution, *Cape Benguela, *Upwelling, Fish populations, Species diversity, Zoogeography, Ocean circulation.

The lanternfishes (fam. Myctophidae) caught during five oceanographic fishing cruises carried out in the Southeast Atlantic between 1979 and 1982 were studied from the point of view of their zoogeography. Four of these cruises took place in the upwelling area of the Benguela Current off the coast of Namibia; during the fifth cruise an oceanic area was also explored, that of the Valdivia Bank, about 400 miles from the coast. A total of 41 species were identified, 10 of which appeared only in the Benguela area, 25 only in the Valdivia Bank and 6 in both areas. The Benguela area showed a low specific diversity and the dominating species were: Lampadena pontifex, Lampanyctus australis, Diaphus dumerilii, Symbolophorus boops, Lampanyctodes hectoris and Diaphus hudsoni. The Valdivia Bank had a high level of diversity, and here the dominating species were: Ceratoscopelus warmingii, Lampanyctus ater, Lepidophanes gaussi, Lampanyctus pusillus, Diaphus anderseni, D. meadi, Scopelopsis multipunctatus and Notoscopelus resplendens. This paper extends the known distribution of some of the species in the Atlantic. The faunistic affinities of each of these two areas were analyzed. In the Benguela area, the upwelling regime imposes peculiar ecological conditions. Some of the aspects related to the lanternfishes that inhabit this area are commented upon. (See also W88-01615) (Author's abstract)
W88-01652

WASTES IN MARINE ENVIRONMENTS.
Office of Technology Assessment, Washington, DC.
Office of Technology Assessment, Washington, DC. 1987. 313 p.

Descriptors: *Marine environment, *Waste disposal, *Water pollution effects, *Ocean dumping, Waste management, Coastal waters, Estuaries, Industrial wastes, Industrial wastewater, Dredging, Sludge disposal, Municipal wastes, Fate of pollutants.

Two congressional committees - the House Committees on Merchant Marine and Fisheries and on Public Works and Transportation - requested OTA to undertake a broad assessment of waste disposal in marine environments. As part of the assessment, OTA issued a report on Ocean Incineration: Its Role in Managing Hazardous Waste (August 1986), and a staff paper on Subseabed Disposal of High-Level Radioactive Waste (May 1986). This final report addresses two fundamental issues: (1) the general condition of different marine environments and the resources; and (2) the role marine environments can and should play in overall waste management. OTA's principal findings are that estuaries and coastal waters are in deep trouble around the Nation, and that more coordinated waste management efforts are needed in many areas. As a Nation, we have been only partially successful in protecting these waters - and their ecologically, commercially, and esthetically valuable resources - from degradation. Policies to maintain or improve their quality, however, must be implemented in conjunction with policies about waste management strategies in general, including disposal in the open ocean and on land. Chapter topics include: marine disposal, impact of waste disposal, statutes and programs relating to marine waste disposal, managing industrial effluent, managing municipal effluent and sludge, and managing dredged material. (Lantz-PTT)
W88-01667

INFLUENCE OF TURBIDITY ON JUVENILE MARINE FISHES IN ESTUARIES. PART 1. FIELD STUDIES AT LAKE ST. LUCIA ON THE SOUTHEASTERN COAST OF AFRICA,
Zululand Univ., Empangeni (South Africa). Dept. of Zoology.
D. P. Cyrus, and S. J. M. Blaber.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 109, No. 1, p 53-70, July 7, 1987. 3 fig, 8 tab, 49 ref.

Descriptors: *Turbidity, *Fish populations, *Estuaries, *Estuarine environment, *Distribution patterns, Fish, Populations, Africa, Lake St. Lucia, Field tests, Coastal waters, Species diversity, Ecological distribution, Water temperature, Food habits, Water quality.

Lake St. Lucia, the largest estuarine system in Africa (325 sq km), was chosen as the field study area for a 3.5 year (1980-83) investigation into the relationships between water turbidity and estuarine fish distribution. The variety of habitats, from clear water and open sandy shores, to shallow muddy substrata and turbid waters, together with high species diversity (108 species) rendered the area suitable for the study. The relationships between fish distribution and environmental factors were monitored by monthly seine netting of fish at seven sites representative of the range of conditions in St. Lucia. Simultaneously, water turbidity, salinity, and temperature were recorded. The possible influences of substratum type and food availability were also investigated using recently published data on invertebrate benthos and zooplankton distributions. The results showed that the distribution of juveniles of the 20 most common fish species were statistically correlated only with water turbidity, water temperature, and food availability. The correlation with temperature was related to seasonal not spatial temperature patterns. Turbidity and food type influences were difficult to separate but exceptions were the anchovy Thryssa vitrirostris (Gilchrist and Thompson) and the sole Soles bleekeri Boulenger, which occurred only in turbid water despite the widespread occurrence of their prey, and Gerres acinaces Bleeker, G. rappi (Barnard), and G. filamentosus Cuvier, all of which occurred only in clear water although the greatest densities of their bivalve prey were in turbid waters. Principal component analysis with a minimum spanning tree plot and a canonical correlation test showed that the fish fauna could be divided into five groups according to their occurrence in various turbidities. It is suggested that turbidity plays a significant role, either singly, or in combination with other variables in determining the distribution of juvenile marine fishes in estuaries. (See also W88-01707) (Author's abstract)
W88-01706

INFLUENCE OF TURBIDITY ON JUVENILE MARINE FISHES IN ESTUARIES. PART 2. LABORATORY STUDIES, COMPARISONS WITH FIELD DATA AND CONCLUSIONS,
Zululand Univ., Empangeni (South Africa). Dept. of Zoology.
D. P. Cyrus, and S. J. M. Blaber.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 109, No. 1, p 71-91, July 7, 1987. 2 fig, 6 tab, 43 ref.

Descriptors: *Turbidity, *Fish populations, *Estuaries, *Estuarine environment, *Distribution patterns, Fish, Populations, Africa, Habitats, Field tests, Correlation analysis, Statistical analysis, Ecological distribution, Coastal waters, Ecosystems, Water quality, Species diversity.

The turbidity preferences of juveniles of 10 marine species common in estuaries of southeastern Africa were investigated in an experimental turbidity gradient. The tests allowed the elimination of all environmental factors except turbidity. Liza dumerilii (Steindachner), was found to be a clear-water species (<10 nepheiometric turbidity units (NTU)); L. macrolepis (Smith), Rhabdosargus sarba (Forsskal), Gerres filamentosus Cuvier, and Valamugil buchanani (Bleeker), preferred 'clear to partially turbid water' (<50 NTU); Monodactylus argenteus (L.) preferred intermediate turbidities (10-80 NTU); and the remaining four, Rhabdosargus holubi (Steindachner), Acanthopagrus berda (Forsskal), Pomadasys commersonni (Lacepede) and Terapon jarbua (Forsskal), were indifferent to turbidity. Statistical analysis of laboratory and field data revealed significant correlations. The results of these are discussed in relation to fish distribution patterns, ecology, and the importance of turbidity to juvenile fishes in estuaries. (See also W88-01706) (Author's abstract)
W88-01707

NUTRIENT ENRICHMENT OF THE CHESAPEAKE BAY,
Maryland Univ., Solomons. Chesapeake Biological Lab.
C. F. D'Elia.
Environment ENTVAR, Vol. 29, No. 2, p 6-11, 30-33, March 1987. 6 fig, 13 ref.

Descriptors: *Nutrients, *Limiting nutrients, *Eutrophication, *Chesapeake Bay, *Water pollution effects, Algal growth, Nitrogen, Phosphorus,

Oxygen, Sediment, Phytoplankton, Bacteria, Non-point pollution sources, Water pollution sources.

The ecological balance of the Chesapeake Bay is changing. Phytoplankton are abundant and growing faster than they can be consumed by other food chain organisms. Upon dying and settling to the bottom they become food for bacteria which then consume all available dissolved oxygen and produce hydrogen sulfide. Sessile bottom dwellers cannot survive while mobile forms are displaced from the habitat. The nitrogen and phosphorus which fuel this eutrophication are anthropogenic, coming from point sources such as sewage treatment facilities which release a nutrient-rich broth, as well as nonpoint sources like agricultural fertilizer. Management agencies differ regarding adequate control measures. Proponents of the upstream source hypothesis maintain that an effective nutrient control strategy would focus on controlling phytoplankton growth in upstream freshwater areas and reducing external sources of oxygen-demanding material. Proponents of a local production hypothesis maintain that an effective management strategy for the downstream zone must curtail local phytoplankton productivity by reducing inputs of the least available nutrient, and therefore the growth regulating nutrient, to that zone. Undetermined is whether nitrogen, phosphorus or some other nutrient limits phytoplankton productivity in downstream midsalinity areas. (McFarlane-PTT)
W88-01802

SUBTIDAL VOLUME EXCHANGE THROUGH THE CHESAPEAKE AND DELAWARE CANAL,
Delaware Univ., Newark. Coll. of Marine Studies.
K. C. Wong.
Journal of Geophysical Research (C) JGRCEY, Vol 92, No. 10, p 10870-10874, September 15, 1987. 6 fig, 13 ref. NOAA Grant No. NA85AA-D0SG033.

Descriptors: *Subtidal volume exchange, *Delaware Canal, *Chesapeake Canal, *Tidal hydraulics, Tidal energy, Tidal amplitude, Hydraulic properties, Estuaries, Hydraulic head.

The Chesapeake and Delaware Canal is a man-made waterway connecting the head of the Chesapeake Bay and the upper reaches of the Delaware estuary. A significant subtidal variability along the canal was found during a 1-month survey in 1975. There were significant differences between subtidal sea level fluctuations at the two ends of the canal, reflecting the different response characteristics of the two adjoining estuaries to atmospheric forcing. The resulting hydraulic head along the canal forced energetic subtidal volume flux through the canal which was of the same order of magnitude as the Delaware River discharge during the spring freshet period. (Author's abstract)
W88-01858

DEVELOPMENT OF A MATHEMATICAL EUTROPHICATION MODEL OF THE LAGOON OF VENICE,
Venice Univ. (Italy). Dept. of Spectroscopy, Electrochemistry and Physical Chemistry.
For primary bibliographic entry see Field 5B.
W88-01873

TWO-DIMENSIONAL DIFFUSION MODEL OF THE VENICE LAGOON AND RELATIVE OPEN BOUNDARY CONDITIONS,
Venice Univ. (Italy). Dept. of Spectroscopy, Electrochemistry and Physical Chemistry.
For primary bibliographic entry see Field 5B.
W88-01874

ADVECTION-DIFFUSION POLLUTION MODEL OF THE LAGOON OF VENICE,
Venice Univ. (Italy). Dept. of Spectroscopy, Electrochemistry and Physical Chemistry.
For primary bibliographic entry see Field 5B.
W88-01875

STEADY-STATE ACHIEVEMENT BY INTRODUCTION OF TRUE TIDAL VELOCITIES IN A POLLUTION MODEL OF THE VENICE LAGOON,
Venice Univ. (Italy). Dept. of Spectroscopy, Electrochemistry and Physical Chemistry.
For primary bibliographic entry see Field 5B.
W88-01876

TIDAL THREE-DIMENSIONAL DIFFUSION IN A MODEL OF THE LAGOON OF VENICE AND RELIABILITY CONDITIONS FOR ITS NUMERICAL INTEGRATION,
Venice Univ. (Italy). Dept. of Spectroscopy, Electrochemistry and Physical Chemistry.
For primary bibliographic entry see Field 5B.
W88-01877

EUTROPHICATION MODEL OF THE VENICE LAGOON: STATISTICAL TREATMENT OF 'IN SITU' MEASUREMENTS OF PHYTOPLANKTON GROWTH PARAMETERS,
Venice Univ. (Italy). Dept. of Spectroscopy, Electrochemistry and Physical Chemistry.
For primary bibliographic entry see Field 5C.
W88-01878

LIGNIN GEOCHEMISTRY OF SEDIMENTS FROM THE NARRAGANSETT BAY ESTUARY,
Battelle New England Marine Research Lab., Duxbury, MA.
A. G. Requejo, J. S. Brown, and P. D. Boehm.
Geochimica et Cosmochimica Acta GCACAK, Vol. 50, No. 12, p 2707-2717, December 1986. 3 fig, 2 tab, 39 ref.

Descriptors: *Geochemistry, *Sediments, *Narragansett Bay, *Lignins, *Water pollution sources, *Rhode Island, Chemical analysis, Cupric oxide, Oxidation, Organic matter, Estuaries.

Cupric oxide oxidation was used to characterize the lignin geochemistry of Narragansett Bay sediments. Lignin concentrations throughout the estuary are low when expressed on a carbon-normalized basis, but can be characterized as enriched when expressed on a mass-normalized basis. This implies substantial dilution of the sedimentary lignin by inputs of lignin-poor carbon. Lignin concentrations do not correlate with the 13-C isotopic composition of the sedimentary organic matter. These results are consistent with a sediment lignin component consisting of varying amounts of vascular plant debris and lignin-depleted organic matter, the latter originating from both marine (planktonic) and terrestrial (uncharacterized) sources. Compositional plots of lignin-derived phenols show that sediments in the upper estuary are influenced to a greater extent by gymnosperm lignin sources than those in the mod- and lower estuary. Given the extent to which the upper estuary is affected by pollution sources, inputs from anthropogenic discharges are the most likely cause of these compositional differences. However, an evaluation of processed paper products as an 'anthropogenic' lignin source indicates that the lignin content of these materials is insufficient to account for the levels found in the sediments. Subsurface lignin compositions at an upper estuary site reveal that lignin originating from the inferred anthropogenic sources disappears at a depth shallower than that which would be expected based on the distribution of other trace organic pollutants (hydrocarbons and several synthetic organic compounds). It is speculated that differences in either the depositional history or the degree of preservation of these two compound classes are responsible for the observed trends. (Author's abstract)
W88-01970

NITROGEN EXCHANGE BETWEEN A SOUTHEASTERN USA SALT MARSH ECOSYSTEM AND THE COASTAL OCEAN,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
G. J. Whiting, H. N. McKellar, B. Kjerfve, and J. D. Spurrier.
Marine Biology MB10AJ, Vol. 95, No. 2, p 173-182, July 1987. 4 fig, 4 tab, 37 ref. NSF Grant Nos. DEB 8004275 and DEB 8119752.

Descriptors: *Salt marshes, *Ecosystems, *Cycling nutrients, *Nitrogen, *Mixing, Tides, Ammonia, Nitrates, Nitrites, Seasonal variation, Estuaries, Nitrification.

The salt marsh ecosystem at North Inlet, South Carolina, consistently exported dissolved inorganic nitrogen via tidal exchange with the coastal Atlantic Ocean. Concentrations of NH4(+) and NO3(-)+NO2(-) displayed distinct tidal patterns with rising values during ebb flow. These patterns suggest the importance of biogeochemical processes in the flux of material from the salt marsh. NH4(+) export peaked during the summer (15 to 20 mg/sq m/tide) during a net balance of tidal water exchange. Remineralization of NH4(+) within the salt marsh system appears to be contributing to the estimated annual net export of about 4.7 NH4(+)-N/sq m/yr. NO3(-)+NO2(-) exports were higher in the fall and winter of 1979 (2 to 4 mg N/sq m/tide). The winter export coincided with a considerable net export of water with no distinctive concentration patterns, suggesting a simple advective export. However, the fall peak of NO3(-)+NO2(-) export occurred during a period of net water balance in tidal exchange and an insignificant freshwater input from the western, forested boundary. During the summer and fall, tidal concentration patterns were particularly apparent, suggesting that nitrification within the salt marsh system was contributing to the estimated annual net export of about 0.6 g NO3(-)+NO2(-)-N/sq m/yr. (Author's abstract)
W88-01995

LONG-TERM (1978-1986) POPULATION TRENDS OF BLACK FIN AMPHIPODS OF PIERRE NOIRE (BAY OF MORLAIX, WESTERM ENGLISH CHANNEL) AFTER THE AMOCO CADIZ DISASTER (EVOLUTION A LONG TERME (1978-1986) DES POPULATIONS D'AMPHIPODES DES SABLES FINS DE LA PIERRE NOIRE (BAIE DE MORLAIX, MANCHE OCCIDENTALE) APRES LA CATASTROPHE DE L'AMOCO CADIZ,
Paris-6 Univ. (France).
For primary bibliographic entry see Field 5C.
W88-02001

NEW, RAPID CLEAN-UP PROCEDURE FOR THE SIMULTANEOUS DETERMINATION OF DIFFERENT GROUPS OF ORGANIC MICROPOLLUTANTS IN SEDIMENTS; APPLICATION IN TWO EUROPEAN ESTUARINE SEDIMENT STUDIES,
Institute for Soil Fertility, Haren (Netherlands).
For primary bibliographic entry see Field 5A.
W88-02007

STUDIES OF HUMIC AND FULVIC ACID DYNAMICS IN COASTAL MARINE WATERS OF SOUTH FLORIDA,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
J. W. Brown.
Marine Environmental Research MERSDW, Vol. 21, No. 3, p 163-174, 1987. 3 fig, 5 tab, 19 ref.

Descriptors: *Humic acids, *Fulvic acids, *Coastal waters, *Estuaries, Florida, Bays, Monitoring, Water chemistry.

Humic and fulvic acid concentrations (HA + FA) were monitored over a two-year period in different areas of Florida and Biscayne Bay. These studies were undertaken in an effort to determine fluctuations in the quantity and chemical nature of humic substances in productive coastal environments in South Florida and, retrospectively, to discern the extent of potential terrestrial influences. Additional studies have been undertaken with material from a South Florida mangrove environment and material isolated from offshore Gulf Stream waters. Dramatic fluctuations in humic substances were observed in all coastal areas. In East-Central Florida Bay, for example, humic materials (HA + FA, collectively) were found to fluctuate as much as elevenfold. In both Biscayne Bay and Florida Bay, these fluctuations appeared to follow the artificial-

ly-controlled input to water from the South Florida mainland. The ratios of FA to HA varied dramatically between terrestrially-influenced and oligotrophic marine environments (i.e. a progressive increase of the FA/HA ratio with this transition). In all marine locations studied, coarse particulate humic substances were low in comparison to the dissolved component of this chemical class. (Author's abstract)
W88-02056

INFLUENCES OF TIDAL WATER POSITION AND SEDIMENTS PHYSICAL PROPERTIES ON THE MEIOFAUNA OF AN ATLANTIC MUD-FLAT (LOIRE ESTUARY, FRANCE) (INFLUENCES DE LA POSITION INTERTIDALE ET DES PROPRIETES PHYSIQUES DES SEDIMENTS SUR LA MEIOFAUNE D'UNE VASIERE ATLANTIQUE (ESTUAIRE DE LA LOIRE, FRANCE)),
Museume National d'Histoire Naturelle, Paris (France).
V. de Fonseca-Genevois, and F. Ottmann.
Comptes Rendus de l'Academie des Sciences (Series 3) CHIDDAT, Vol. 304, No. 7, p 161-166, February 1987. 1 fig, 8 ref.

Descriptors: *Mud-flats, *Sediments, *Interstitial water, *Sampling, *Tides, *Estuaries, Tidewater, Tidal flats, Porosity, Permeability, Loire River.

The roles of sample position with respect to the tide, and of sediment and interstitial water properties are defined in relation to the distribution of meiofaunal groups. Samples were taken at five stations (numbered I to V from bottom to top), of which only three were studied in detail, given the similarity of the meio- and mixofaunal composition of the even and odd stations. Only the surface meiofauna (0-2 cm) and the sediment physical properties linked to interstitial water: water content, porosity, permeability were addressed. Two conclusions: it is indespensable, in the case of studies of the distribution of meiofauna in tidal water bodies, to specify accurately the elevation of the sample and to study the sediment physical properties (beyond the usual granulometry); also, as concerns ecological needs, it appears that the amount of interstitial water is a fundamental factor in the distribution of meiofauna in zones which undergo emersion. (Airone-PTT)
W88-02100

LOW SALINITY INDUCES REVERSIBLE TISSUE REGRESSION IN THE ESTUARINE SPONGE MICROCIONA PROLIFERA (ELLIS AND SOLANDER),
Connecticut Coll., New London. Dept. of Zoology.
P.-A. Knight, and P. E. Fell.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 107, No. 3, p 253-261, April 1987. 4 fig, 3 tab, 17 ref.

Descriptors: *Salt tolerance, *Salinity, *Saline water, *Estuaries, *Animal tissues, *Sponges, *Tissue regression, Estuarine environment, Animal physiology, Animal growth.

Explants of Microciona prolifera (Ellis and Solander) maintained in laboratory culture at either 2.0 or 1.5% salinity retained a normal tissue organization. Explants gradually transferred to 1.0% underwent tissue regression during which flagellated chambers, canals, subdermal spaces and oscula disappeared. When the explants were gradually returned to 2.0%, these structures redeveloped. Reproductive activity in the explants appeared to be normal at 2.0%, somewhat slowed at 1.5%, and inhibited at 1.0%. (Author's abstract)
W88-02129

UPTAKE OF KEPONE BY THE ESTUARINE BIVALVE RANGIA CUNEATA, DURING THE DREDGING OF CONTAMINATED SEDIMENTS IN THE JAMES RIVER, VIRGINIA,
Virginia State Water Control Board, Richmond.
For primary bibliographic entry see Field 5B.
W88-02339

LOW SALINITY INDUCES REVERSIBLE TISSUE REGRESSION IN THE ESTUARINE SPONGE MICROCIONA PROLIFERA (ELLIS AND SOLANDER),
Connecticut Coll., New London. Dept. of Zoology.
P.-A. Knight, and P. E. Fell.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 107, No. 3, p 253-261, April 1987. 4 fig, 3 tab, 17 ref.

Descriptors: *Salinity, *Tissue analysis, *Salt tolerance, *Sponges, Reproduction, Cultures, Estuaries.

Explants of Microciona proligera (Ellis and Solander) maintained in laboratory culture at either 2.0% or 1.5% salinity retained a normal tissue organization. Explants gradually transferred to 1.0% underwent tissue regression during which flagellated chambers, canals, subdermal spaces and oscula disappeared. When the explants were gradually returned to 2.0%, these structures redeveloped. Reproductive activity in the explants appeared to be normal at 2.0%, somewhat slowed at 1.5%, and inhibited at 1.0%. (Author's abstract)
W88-02368

RELATIONSHIP BETWEEN LEAD CONCENTRATIONS IN SEAWATER AND IN THE MUSSEL MYTILUS EDULIS: A WATER-QUALITY CRITERION,
Victoria Coll., Clayton (Australia). Rusden Campus.
For primary bibliographic entry see Field 5B.
W88-02370

INFLUENCE OF ENVIRONMENTAL VARIABLES ON THE FISH FAUNA OF THE DEEPER WATERS OF A LARGE AUSTRALIAN ESTUARY,
Murdoch Univ. (Western Australia). School of Environmental and Life Science.
N. R. Loneragan, I. C. Potter, R. C. J. Lenanton, and N. Caputi.
Marine Biology MBIOAJ, Vol. 94, No. 4, p 631-641, May 1987. 6 fig, 7 tab, 38 ref.

Descriptors: *Estuaries, *Salinity, *Species composition, *Rivers, *Fish populations, *Australia, Regression analysis, Biomass, Temperature.

Fish were collected by gill nets from the deeper waters of the Entrance Channel, basins and rivers of the large Peel-Harvey estuarine system of south-western Australia in the wet (June to November) and dry (December to May) periods between August 1979 and July 1981. Simple regression analysis showed that the number of species, abundance and biomass of fish in the rivers rose with increases in the salinity and temperature of both the surface and bottom of the water column. No such significant correlations were found in the Entrance Channel and basins (Peel Inlet and Harvey Estuary), where salinity changes were far less marked. The number of species at sites throughout the estuary was inversely correlated with distance from the estuary mouth. Multiple-regression equations showed that, compared with the other environmental variables tested, bottom salinity had a greater influence on the number of species and abundance both in the rivers and in the system as a whole. These results indicate that salinity has a greater effect on the fauna in the deeper waters than in the shallows. The larger fish which characterise the deeper waters may thus be less tolerant to low salinities than the smaller fish typically found in the shallows. Both classification and ordination separated the faunal composition of the rivers from those of the Entrance Channel and basins. The fauna of the two narrow and deeper sites in the rivers separated into wet- and dry-period components. Differences between the faunal composition of the riverine regions and those of the Entrance Channel and basins have been related to the much more variable and lower minimum salinities in the rivers. Species characteristic of the rivers included Amniataba caudavittatus, which is estuarine sensu stricto in south-western Australia, the semi-anadromous Nematalosa vlaminghi and the highly euryhaline Mugil cephalus. The indicator species for the Entrance Channel and basins were all marine species (Cnidoglanis macrocephalus, Hyporhamphus melanochir, Gerres subfasciatus and Pomatomus saltator). (Author's abstract)
W88-02371

REPRODUCTIVE BIOLOGY AND THE PATHOLOGICAL CHANGES OF THE PLAICE PLEURONECTES PLATESSA (L.) AFTER THE 'AMOCO CADIZ' OIL SPILL ALONG THE NORTH-WEST COAST OF BRITTANY,
Universite de Bretagne-Occidentale, Brest (France). Lab. de Biologie Animale.
For primary bibliographic entry see Field 5C.
W88-02372

IMPACT OF A GYRODINIUM AUREOLUM BLOOM ON INSHORE YOUNG FISH POPULATIONS,
Marine Biological Association of the United Kingdom, Plymouth (England).
G. W. Potts, and J. M. Edwards.
Journal of the Marine Biological Association of the United Kingdom JMBAAK, Vol. 67, No. 2, p 293-297, May 1987. 1 fig, 11 ref.

Descriptors: *Eutrophication, *Coastal waters, *Dinoflagellates, *Fish pathology, Larvae, Surveys, Population dynamics.

During August 1986 a bloom of the dinoflagellate, Gyrodinium aureolum occurred at a survey site off Plymouth Breakwater. The cell concentration of the dinoflagellates was so great that the water appeared a greenish-brown color. Direct underwater observations showed that larval, post-larval and young fish were affected by the bloom, and instead of being widely distributed over the reefs and into the water column, the young fish were confined to within 50 cm of the bottom. Meter net surveys taken over the bottom during the summer period showed a dramatic reduction in the numbers of larval and young fish stages following the bloom. (Author's abstract)
W88-02373

HYDROGRAPHY AND THE DISTRIBUTION OF PHYTOPLANKTON IN KILLARY HARBOUR: A FJORD IN WESTERN IRELAND,
Shellfish Research Lab., Carna (Ireland).
C. M. Roden, P. G. Rodhouse, M. P. Hensey, T. McMahon, and T. H. Ryan.
Journal of the Marine Biological Association of the United Kingdom JMBAAK, Vol. 67, No. 2, p 359-371, May 1987. 10 fig, 1 tab, 18 ref. National Board of Science and Technology (Ireland) Grant HEIC 11/79.

Descriptors: *Fjords, *Phytoplankton, *Salinity, *Estuaries, *Harbors, *Brackish water, *Haloclines, Chlorophyll, Coastal waters, Growth, Rainfall.

The factors influencing the growth of phytoplankton in a fjord, Killary Harbour, are described. Two phytoplankton habitats are distinguished, a seaward flowing brackish surface layer and a more saline water mass in the outer harbor. The brackish layer is characterized by colored, low salinity water, bounded by a very sharp halocline. Cholorphyll concentrations are high only at the surface and several species are restricted to this layer. In the outer harbor, salinities exceed 3.0%, the water is more transparent and a sharp halocline is not found. Phytoplankton blooms are concentrated at depth (5-10 m) and mostly consist of coastal species. The horizontal extent of the brackish layer is very variable and is influenced by rainfall. The distribution of phytoplankton reflects this variability. Primary production is inversely correlated with the size of the brackish layer. (Author's abstract)
W88-02374

MODELLING OF A PLANKTONIC ECOSYSTEM IN AN ENCLOSED WATER COLUMN,
Station Zoologique, Villefranche-sur-Mer (France).
V. Andersen, P. Nival, and R. P. Harris.

Journal of the Marine Biological Association of the United Kingdom JMBAAK, Vol. 67, No. 2, p 407-430, May 1987. 8 fig, 9 tab, 64 ref. NSF Grant OCE-77-27906; Electricite de France Grant 62-646.

Descriptors: *Model studies, *Estuaries, *Plankton, *Ecosystems, Herbivores, Population dynamics, Nutrients, Diatoms.

A model of a planktonic ecosystem in an enclosed water column is described, based on enclosure CEE 3 of the CEPEX project, carried out in Saanich Inlet, British Columbia during the summer of 1978. This type of study of an isolated body of water, rather than in the open sea, facilitates a better estimation of trophic interactions. An initial model in which the phytoplankton and herbivores are considered as single compartments is described. It is shown that such a simple model does not adequately represent the development of the plankton populations within the enclosure. It is necessary to consider separate categories of phytoplankton, of nutrients and of herbivores. Consequently the second model described includes diatom and flagellate compartments, as well as dissolved inorganic nitrogen and silicate, and copepods and appendicularians. This final model reproduces the general evolution of the variables in the enclosure, but suggests that a further subdivision of the system is necessary, for example by considering the different classes of flagellates. (Author's abstract)
W88-02375

BIOGENIC HYDROGEN SULFIDE EMISSIONS FROM SELECTED FLORIDA WETLANDS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W88-02463

ORGANOCHLORINE PESTICIDE CONTENTS OF TRIBUTARIES INTO BLANCA BAY, ARGENTINA,
Instituto Argentino de Oceanografia, Buenos Aires. Lab. de Quimica Marina.
For primary bibliographic entry see Field 5B.
W88-02483

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

STUDY OF SALINE WATER USE AT THE ETIWANDA GENERATING STATION,
J. K. Laughlin.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB87-187142, A05 in paper copy, A01 in microfiche. Final Report, March 16, 1987. Task 3, Basic Agreement No. 4-AB-81-03600.

Descriptors: *Water treatment, *Saline water, *Water reuse, *Etiwanda Generating Station, Salinity, Powerplants, Ion exchange, Water softening, Costs, Water supply.

Water treatment process options were evaluated for the use of Palo Verde Irrigation Outfall Drain as a major water supply for a hypothetical coal-fired powerplant located in the Mojave Desert between Blythe, California, and Las Vegas, Nevada. The study was done in conjunction with a field test of ion exchange softening technology conducted at the Etiwanda Generating Station near San Bernardino, California. Data from the field test program were used to support the design and cost evaluations of ion exchange softening technology in the study. Sidestream lime/soda softening was the most cost-effective process option for treating Palo Verde Irrigation Outfall Drain water quality. Ion exchange softening technology, using cooling tower blowdown for regeneration appears to be technically viable based on short-term testing, and is likely to be competitive in cost for waters high in hardness, high in sodium, and low in silica. (Author's abstract)
W88-01611

METHOD OF REVERSE OSMOSIS EMPLOYING AN IMPROVED POROUS GLASS MEMBRANE,
National Research Development Corp., London (England).
P. W. McMillan, and R. Maddison.
U.S. Patent No. 4,473,476; September 25, 1984, 3 p, 2 ref. Official Gazette of the United States Patent Office, Vol 1046, No 4, p 1639, September 25, 1984.

Descriptors: *Patents, *Reverse osmosis, *Membrane processes, *Desalination, *Porous media, *Glass, Saline water, Seawater, Water treatment, Silicates, Porosity, Titanium, Chlorides, Coatings, Hyperfiltration.

Porous glass coated with a metal oxide is applied as a semi-permeable membrane for reverse osmosis desalination. A membrane of a sodium-boron-alumino silicate glass is made using the following steps: treat the membrane to cause phase separation; remove one of the phases to form a porous glass membrane; dry the glass in a stream of nitrogen; heat the porous glass membrane prior to deposition of a volatile metal chloride; volatilize the metal chloride and introduce it into the stream of nitrogen to deposit it on the porous glass membrane; hydrolyze the metal chloride surface layer to produce a coating of metal chloride; and rehydrate the porous glass membrane by immersing it in water. The metal chloride is titanium chloride and the porous glass membrane is heated to at least 80 C to form the titanium chloride surface layer. (Cremmins-AEPCO)
W88-01786

SCALE INHIBITOR FOR REVERSE OSMOSIS WATER PURIFICATION SYSTEM,
Goodrich (B.F.) Co., Akron, OH.
A. G. Kapiloff, and R. T. Hatch.
U.S. Patent No. 4,460,472; July 17, 1984, 6 p, 2 fig, 4 ref. Official Gazette of the United States Patent Office, Vol 1044, No 3, p 1216, July 17, 1984.

Descriptors: *Patents, *Reverse osmosis, *Membrane processes, *Water treatment, *Scaling, *Inhibition, Calcium, Magnesium, Iron, Inhibitors, Acids, Saline water, Brackish water, Desalination.

Calcium, magnesium, iron scale are inhibited in reverse osmosis (RO) water purification systems using low molecular weight polyacrylic and phytic acid inhibitors. When low molecular weight polyacrylic acid is used alone, calcium and magnesium scale is inhibited to a point where removal and cleaning of the membrane is unnecessary for several months. Phytic acid is at least as efficient as low molecular weight polyacrylic acid in inhibiting calcium and magnesium scale build up on RO membranes. Phytic acid is also effective in inhibiting iron scale on RO membranes when used in actual field conditions where the feedwater is saline or brackish. Low molecular weight polyacrylic and phytic acid combined produce a synergistic effect whereby they not only inhibit the growth of calcium and magnesium scale but also the growth of iron scale, and the total amount of inhibitor needed to achieve the desired result is decreased by an amount more than would be expected from the additive effect of the two ingredients. (Cremmins-AEPCO)
W88-01787

REVERSE-OSMOSIS PURIFIER APPARATUS AND METHOD,
T. V. Tyler, and R. B. Sprague.
U.S. Patent No. 4,391,712; July 5, 1983, 7 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1032, No 1, p 253, July 5, 1983.

Descriptors: *Patents, *Reverse osmosis, *Water treatment, *Membrane processes, *Domestic water, *Desalination, Water storage, Pollution prevention, Filtration, Closed systems, Salts.

A reverse osmosis (RO) water purification system for domestic use saves water and prevents reductions in purity owing to osmosis during shutdown. After water is drawn from a pure water storage element following a period of shutdown of the system, water from the pure water side of the RO unit is not conducted to the element. Shutdown of the system occurs when there is enough water in the pure water storage tank to fill it. Valve and accumulator components receive and store, under pressure, the first quantity of water discharged from the RO unit after shutdown. When the system shuts down a second time, the stored water is discharged automatically to a drain. The system is closed continuously, which prevents contamination of the water passing to the storage tank. (Cremmins-AEPCO)
W88-01788

DISCHARGE OF GASES FROM SUBMARINE DESALINATION PLANTS,
Mannesmann A.G., Duesseldorf (Germany, F.R.).
B. Drude, T. Peters, and E. Klapp.
U.S. Patent No. 4,414,114; November 8, 1983, 5 p, 3 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1036, No 2, p 605, November 8, 1983.

Descriptors: *Waste disposal, *Patents, *Desalination, *Water treatment, *Reverse osmosis, *Submarines, Seawater, Reclaimed water, Pressurization, Membrane processes, Desalination plants.

Gases developed as undesired by-products in submarine desalination plants are discharged into the surrounding seawater. The undesired gases are fed from a desalination vessel into a second vessel using pressurized freshwater produced to pressurize the gases in the second vessel. The pressurized gases are then discharged into the surrounding sea, while the freshwater is reclaimed. For the gas pressurization, excess pressure over the hydrostatic pressure of the surrounding sea is developed. The system can be applied in other environments provided a relatively high pressure liquid is available to pressurize the gases discharged from a location in which their presence is undesirable. (Cremmins-AEPCO)
W88-01789

MULTI-CYLINDER REVERSE OSMOSIS APPARATUS AND METHOD,
B. G. Keefer.
U.S. Patent No. 4,434,056; February 28, 1984, 16 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1039, No 4, p 1590-1591, February 28, 1984.

Descriptors: *Patents, *Reverse osmosis, *Desalination, *Water treatment, *Membrane processes, *Ultrafiltration, *Pumps, Separation techniques, Salts, Seawater, Saline water, Conduits, Pumping.

A reciprocating feed pump for water desalination and purification by multi-cylinder reverse osmosis separates a feed fluid into permeate and concentration fluid fractions, which are permeated and rejected by selective membranes. The pump contains at least three feed cylinders. Each cylinder contains a displacer that is made reciprocable within the respective cylinder using a displacer rod. The displacer divides each cylinder into expansion and pumping chambers having relative displacements which approximately determine recovery approximately determine recovery ratios of permeate fluid fractions to total feed fluid flow. Each pumping chamber communicates with a valved inlet conduit to admit feed fluid and with a valved outfeed conduit to conduct feed fluid to the membranes. Each cylinder also has a corresponding expansion chamber valve to control flow relative to the corresponding expansion chamber. The valve controlling the expansion chamber of each cylinder has a closed intermediate position which provides a dwell period. (Cremmins-AEPCO)
W88-01790

REVERSE OSMOSIS APPARATUS AND METHOD INCORPORATING EXTERNAL FLUID EXCHANGE,
Seagold Industries Corp., Burnaby (British Columbia).
B. G. Keefer.
U.S. Patent No. 4,432,876; February 21, 1984, 12 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1039, No 3, p 1184, February 21, 1984.

Descriptors: *Patents, *Reverse osmosis, *Membrane processes, *Ultrafiltration, *Pumps, *Desalination, *Water treatment, Separation techniques, Pumping, Conduits, Seawater, Salts, Feedwater treatment, Saline water.

A pumping apparatus for water desalination and purification by reverse osmosis separates a feed fluid into permeate and concentrate fluid fractions, which are permeated and rejected by selected membranes. The pumping apparatus includes a reciprocating feed pump; conduit, valve, and dwell systems; and a system to reduce fluctuations in pressure and fluid flow across the membranes. The dwell system is disposed externally of the feed pump to permit the use of a simpler rigid piston and relatively easy servicing of the system. The external dwell system also can be used either for simple exchange of volume between pumping and expansion chambers or can provide actual fluid intermixing between the pumping and expansion chambers. (Cremmins-AEPCO)
W88-01791

REVERSE OSMOSIS METHOD AND APPARATUS,
B. G. Keefer.
U.S. Patent No. Re. 32,144, May 13, 1986, 17 p, 9 fig. Official Gazette of the United States Patent Office, Vol 1066, No 2, p 532, May 13, 1986.

Descriptors: *Patents, *Ultrafiltration, *Reverse osmosis, *Water treatment, *Desalination, Flow control, Pumping, Permeability, Separation techniques, Membrane processes.

Reverse osmosis and ultrafiltration fluid separation processes desalinate and purify water. A membrane separation apparatus separates the feed fluid into permeate and concentrate fluid fractions, which are permeated or rejected by semipermeable membranes. The separation apparatus consists of a reciprocating pump; inlet, outfeed, and return conduits; a system for communicating with the membrane to provide uniform pressure and feed flow across the membranes; first and second valves for directing fluid to and from the membranes; and a dwell system to ensure timely valve actuation. The reciprocating pump contains a cylinder and movable piston, which divides the cylinder into a pumping chamber in which feed fluid is pressurized and an expansion chamber in which the concentrate fluid is depressurized. The piston also separates the pumping and expansion chambers and cooperates with the piston rod extending through the expansion chamber. (Cremmins-AEPCO)
W88-01792

METHOD OF PRODUCING ULTRAPURE, PYROGEN-FREE WATER,
For primary bibliographic entry see Field 5F.
W88-01794

PROCESS AND APPARATUS FOR RECOVERING USABLE WATER AND OTHER MATERIALS FROM OIL FIELD MUD/WASTE PITS,
Romec Environmental Research and Development, Inc., College Station, TX.
For primary bibliographic entry see Field 5D.
W88-01795

DISTILLATION SYSTEM AND PROCESS,
Vaponics, Inc., Plymouth, MA.
V. C. Smith.
U.S. Patent No. 4,344,826 August 17, 1982. 5 p, 2 fig. Official Gazette of the United States Patent Office, Vol 1021, No 3, p 958-959, August 17, 1982.

Descriptors: *Desalination, *Desalination apparatus, *Patents, *Reverse osmosis, *Vapor compression distillation, *Water treatment, *Distilled water, *Membrane processes, Heating, Feedwater treatment, Raw water.

Distillation using the membrane surface bypass method and reduced feed water increases reverse osmosis (RO) wastewater efficiency and provides a system for heating the RO unit. The waste output of the RO unit is conveyed to the condenser cooling coil of the still, where it is used rather than wasted. A portion of the coil output is recirculated to the RO unit inlet, where a temperature mixing valve with inlets fed by feed water and condenser output water mixes the two in response to a temperature control. Water from the mixing valve, at a temperature suitable for optimum use of the RO unit, is then fed to the RO unit. (Cremmins-AEPCO)
W88-01796

METHOD OF PRETREATING RAW WATER FOR REVERSE OSMOSIS UNITS,
Steinmueller (L. und C.) G.m.b.H., Gummersbach (Germany, F.R.).
K. M. Pohl, and G. Winkler.
U.S. Patent No. 4,261,833, April 14, 1981 4 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1005, No 2, p 703, April 14, 1981.

Descriptors: *Patents, *Reverse osmosis, *Seawater, *Water treatment, *Desalination, *Pretreatment of water, Separation techniques, Acids, Salts, Centrifugation, Raw water.

Raw water, such as seawater, is prepurified for supply to reverse osmosis units. An aqueous solution of acid salt and acid with the same anions is mixed with the raw water to obtain the most advantageous pH value for the reverse osmosis. The acid salt is converted into the corresponding hydroxide. After possible addition of flocking or flaking additives, the resulting strongly concentrated hydroxide flakes are separated out by means of a plate or disc centrifuge, and are brought back into solution again as a salt together with fresh metallic salt. After mechanical purification in a second plate or disc centrifuge, the flakes are resupplied to the raw water. The pretreated raw water exists under pressure from the separator through which it flows and, alternatively, a chemical reducing agent may be added to the departing water flow. (Cremmins-AEPCO)
W88-01797

WATER PURIFICATION PROCESS AND SYSTEM,
Allied Water Corp., San Francisco, CA.
J. P. Pelmulder.
U.S. Patent No. 4,243,523; January 6, 1981. 9 p, 7 fig. Official Gazette of the United States Patent Office, Vol 1002, No 1, p 261, January 6, 1981.

Descriptors: *Patents, *Desalination, *Water treatment, *reverse osmosis, *Seawater, *Saline water, Membrane processes, Drinking water, Water supply, Flow velocity, Brines, Potable water, Water treatment.

A reverse osmosis seawater desalination system for small-scale use in households or on small boats has low power or energy requirements, achieves the required minimum flow velocity using membrane elements with a large ratio of brine flow to product flow, and provides a minimum water supply under drought or changed local conditions. A membrane element with an inlet and an outlet and having a flow cross-section with a width to height ratio of greater than fifty is used. A feed flow is established at a pressure in excess of the osmotic pressure to one side of the membrane element and at a rate less than sufficient to maintain the design minimum flow velocity in the flow cross-section of the membrane. A portion of the concentrate is recirculated from the outlet to the inlet of the membrane element at a pressure in excess of the osmotic pressure and the feed flow pressure at a rate sufficient to cause the flow velocity at the surface of the membrane to exceed the design minimum flow velocity. The concentrate is recirculated at a rate less than the design minimum flow velocity in the flow cross-section of the membrane. The permeate product passing through the membrane is recovered while maintaining the feed flow at a rate sufficient to maintain salinity in the permeate product at or below a maximum acceptable level. Concentrate is continuously discharged at a rate substantially equal to the difference between the feed flow rate and the recovery permeate product rate. (Cremmins-AEPCO)
W88-01798

REVERSE OSMOSIS DESALINIZATION UTILIZING PLURAL FLOW WORK EXCHANGE VESSELS,
Steinmueller (L. und C.) G.m.b.H., Gummersbach (Germany, F.R.).
K. M. Pohl.
U.S. Patent No. 4,354,939; October 19, 1982. 16 p, 12 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1023, No 3, p 944, October 19, 1982.

Descriptors: *Patents, *Desalination, *Reverse osmosis, *Membrane processes, *Saline water, *Water treatment, Brackish water, Seawater, Industrial water, Drinking water, Salts, Separation techniques.

A salt containing solution is separated into a salt-poor permeate and a salt-rich concentrate using reverse osmosis (RO) desalination. Sea water having a salt content of 38,000 ppm at an initial pressure (P sub O) is separated into a low salt permeate having a salt content of 500 ppm at pressure (P sub O) by pressuring the solution to high pressure (P sub 1) in an input line upstream of a RO permeable membrane. The efficiency of the process is increased by utilizing first and second displacement vessels having rigid internal surfaces divided by a flexible wall into a first chamber connected to the RO vessel and a second chamber connected to the input line of the vessel. Energy can be conserved by using conventional pumps without depressurizing devices for the concentrate. (Cremmins-AEPCO)
W88-01799

MEMBRANE PROCESSES IN ENVIRONMENTAL PROTECTION (MEMBRANVERFAHREN IN DER UMWELTTECHNIK),
Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Verfahrenstechnik.
For primary bibliographic entry see Field 5D.
W88-02102

WATER CONSERVATION AND MANAGEMENT IN BARROW, ALASKA,
Northern Testing Lab., Inc., Fairbanks, AK.
For primary bibliographic entry see Field 3D.
W88-02312

RATIONAL BASES FOR DESIGNING VAPOUR COMPRESSION WATER DESALINATION SYSTEMS,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Mechanical Engineering.
M. M. Elsayed.
Desalination DSLNAH, Vol. 58, No. 3, p 213-225, May 1986. 9 fig, 2 tab, 6 ref, append.

Descriptors: *Water treatment, *Desalination systems, *Design standards, *Model studies, Performance evaluation, Brines, Evaporation, Costs, Vapor compression desalination.

A rational basis for the design of a vapor compression desalination (VCD) system is given. This is carried out through defining five design parameters on which the performance of the VCD system depends. These five parameters are the feed to distillate ratio (F/D), the effectiveness of the brine feed heater (k sub B), the feed temperature to the VCD system (T sub 1), the evaporator temperature (T sub E), and the temperature difference (Delta T) between heating steam and boiling brine in the evaporator. The performance of the various components of the system is then mathematically modeled in terms of these design parameters. Quantitatively, the effects of varying each design

parameter on the variation of the fixed and operating costs are considered. The fixed cost includes the cost of the evaporator, double stream heat exchanger, and the compressor. The operating cost includes the cost of the auxiliary heat supplied to the evaporator and the cost of the compression work. (Author's abstract)
W88-02428

PRETREATMENT OF SEAWATER BY FLOCCULATION AND SETTLING FOR PARTICULATES REMOVAL,
Hebrew Univ. Jerusalem (Israel). Graduate School of Applie Science and Technology.
A. Adin, and C. Klein-Banay.
Desalination DSLNAH, Vol. 58, No. 3, p 227-241, May 1986. 8 fig, 1 tab, 18 ref.

Descriptors: *Particulate matter, *Pretreatment of water, *Water treatment, *Flocculation, *Membrane processes, *Seawater, Salinity, Turbidity, Clays, Algae, Alum.

Seawater flocculation was studied in this investigation as an aid in preventing fouling of reverse osmosis (RO) membranes by particulates. The behavior of clays in seawater and their possible use in the pretreatment process was also investigated. Mediterranean seawater samples were found to have a salinity of about 3.6%, pH of 7.9-8.2 and turbidity of 1.0-17.5 NTU (Nephelometric Turbidity Units). After 1-3 h of quiescent settling, 30-50% of the turbidity remained and then stabilized, pointing to a possible advantage of lagooning prior to further treatment. Tests carried out with artificial seawater, as well as natural seawater, were carried out to study particle removal in general, and algae and clay in particular. Different conventional and polyelectrolytic flocculants were used in the experiments. The best clarification was found using alum and an anionic polymer in combination, resulting in 20-100 particles per ml and a turbidity of less than 1 NTU. It was also found that particle size distribution measurements may provide a better picture of the quality and mechanism of treatment. (Author's abstract)
W88-02429

COMBINED RO/VC DESALINATION SYSTEM,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Mechanical Engineering.
S. E. Aly.
Desalination DSLNAH, Vol. 58, No. 2, p 85-97, April 1986. 4 fig, 12 ref.

Descriptors: *Water treatment, *Desalination systems, *Design standards, *Reverse osmosis, *Vapor compression, Superheating, Performance evaluation, Brines, Evaporation, Costs.

An analysis of a combined reverse osmosis (RO) and a mechanical vapor compression (VC) desalination system suitable for remote areas or small communities is presented. This system consists of an RO unit with a recovery ratio of 25% and is driven by a diesel engine which is also coupled to the VC, and has a total output of 705 sq m/d. Vapor discharged from the VC is superheated using a portion of the waste heat from the exhaust of the diesel engine. The degree of superheating is converted, in a desuperheater, into a 12% mass increase of saturated vapor at 112 C. This introduced to a 3-effect VTE unit with the third effect working at atmospheric pressure and is connected to the suction side of the VC. Eleven flashing chambers are used for feed heating with a bottom temperature of 56 C. The pretreated RO brine, at high pressure, is used to cool the diesel engine. Then it is heated further, using both distillate and blowdown effluent from the bottom stage of the VTE feed heaters. Thermodynamic analysis of the combined system showed that about 46% more fresh water is produced than that for the RO alone at the expense of 29% extra diesel power. Pumping power required to circulate the flow in various parts of the system is saved, and the whole system can be designed as a mobile one, contributing to its advantages. (Author's abstract)
W88-02430

EFFICIENT ENERGY UTILIZATION IN SINGLE PURPOSE DESALINATION PLANTS,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Mechanical Engineering.
S. E. Aly.
Desalination DSLNAH, Vol. 58, No. 2, p 99-112, April 1986. 7 fig, 2 tab, 10 ref.

Descriptors: *Water treatment, *Desalination systems, *Design standards, Performance evaluation, Brines, Case studies, Comparison studies, Evaporation, Costs, Energy, Thermodynamics.

Thermodynamic analyses and case studies were carried out on hybridized systems designed to improve single purpose desalination (SPD) plants. The first system considered is a conventional SPD connected to a steam generator by a pressure reducing valve (PRV). In the second system, this is replaced by a mechanical vapor compression MVC/MED unit, and in the third system by a thermovapor compression TVC/MED unit. In the fourth system, a reverse osmosis (RO) unit replaced the PRV, thus using the supplied steam to produce more fresh water. Results of the analysis emphasize the extra water produced and the overall performance ratio increase of the plant. The included case study showed that the plant performance of the SPD was significantly improved by using any of the above systems. The extra water produced amounted to 96, 84 and 46% of the initial plant production in the second, third and fourth system respectively. (Author's abstract)
W88-02431

TREATMENT OF DISTILLATES AND PERMEATES FROM SEAWATER DESALINATION PLANTS,
Fichtner, Beratende Ingenieure fuer Energie- und Waermewirtschaft G.m.b.H. und Co. K.G., Stuttgart (Germany, F.R.)
H. Ludwig, and M. Hetschel.
Desalination DSLNAH, Vol. 58, No. 2, p 135-154, April 1986. 17 fig.

Descriptors: *Water treatment, *Desalination, *Membrane processes, *Seawater, Water treatment facilities, Evaporation, Reverse osmosis, Potable water.

Seawater desalination by evaporation or reverse osmosis processes is of rather great importance for potable water supply in countries without sufficient natural water sources. The distillate produced by evaporation as well as the permeate produced by reverse osmosis have to be treated to achieve satisfactory properties with respect to corrosiveness and health aspects. The paper discusses the composition and properties of distillate and permeates and the different remineralization and potabilization processes to make potable water and to avoid corrosion in the potable water system. (Author's abstract)
W88-02432

COMPUTER ANALYSIS JUSTIFIES DESALINATION,
University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Programme.
D. Stephenson.
Desalination DSLNAH, Vol. 58, No. 2, p 155-167, April 1986. 5 fig, 3 tab, 10 ref.

Descriptors: *Computer programs, *Automation, *Water supply, *Drinking water, *Economic aspects, *Desalination, *Water treatment, Computers, Flow, Water quality, Costs.

Whereas it is recognized that desalination is not economically justifiable in many water supply situations, this paper describes how by careful replanning of the water distribution system in a gold mine, the installation of a desalination plant underground can be shown to be economic despite cheaper fresh water being available on the surface. The advantage is largely in the reduction in pumping costs of return water together with the cost of the fresh water. The optimum distribution pattern to meet quality requirements can be selected using a computer program developed for this purpose. The program receives data on minimum flow requirements and quality constraints and adjusts flows around closed loops in a way which meets operating requirements whilst minimizing total distribution costs. (Author's abstract)
W88-02433

IMPACTS AGAINST THE WALL OF A SCALED-UP FLUIDIZED BED,
Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Delft (Netherlands).
J. A. M. Meijer, J. A. Wesselingh, A. Clobus, and M. L. A. Goossens.
Desalination DSLNAH, Vol. 58, No. 1, p 1-18, February 1986. 6 fig, 2 tab, 17 ref.

Descriptors: *Desalination, *Mathematical equations, *Comparison studies, *Hydrodynamics, *Fluidized beds, *Impact velocity, Kinetics, Energy, Fluid mechanics, Porosity.

A scaled-up fluidized bed permitted the accurate of determination of impact parameters, due to the relative improvement of the impact measuring system. The mean perpendicular kinetic energy per impact and the mean impact frequency per unit area, calculated by the equations derived by Bordet et al., did not agree with the experimentally determined values in the scaled-up fluidized bed. When these equations were used to calculate the same parameters for the original fluidized bed as applied in an MSF/FBE, again considerable deviations were found with the scaled-down experimental values. The Maxwell-Boltzmann velocity distribution calculated for the fluidized bed system appeared not to be valid when the values of comparatively low velocity impacts were included. The mean perpendicular velocity at impact was about a factor 10 lower than the superficial fluid velocity at a porosity of 0.8. The porosity of the fluidized bed measured as a function of the superficial fluid velocity appeared to be in good agreement with the equation derived by Richardson and Zaki. (Author's abstract)
W88-02434

EFFECT OF CELL THICKNESS AND FLOW VELOCITY ON WATER COST IN DESALINATION BY ELECTRODIALYSIS,
GKSS - Forschungszentrum Geesthacht G.m.b.H., Hamburg (Germany, F.R.).
K. Hattenbach, and K. Kneifel.
Desalination DSLNAH, Vol. 58, No. 1, p 33-41, February 1986. 5 fig, 2 tab, 8 ref.

Descriptors: *Computer programs, *Membrane processes, *Economic aspects, *Water treatment, *Desalination systems, *Design standards, Performance evaluation, Brines, Evaporation, Costs, Flow velocity, Flow.

The effect of cell thickness and flow velocity on product water cost was investigated in order to obtain data for optimizing electrodialysis membrane stacks in water desalination. The calculations were carried out by means of a computer program; the experimental data were obtained from the determination of limiting current densities. The results indicate that a reduction of cell thickness to approximately 0.2 mm with a corresponding flow velocity of 0.13-0.17 m/s yields a cost minimum. However, this minimum cannot be identified exactly. Moreover it would be difficult to manufacture adequate sealing frames and to obtain a homogeneous flow distribution in such cells simultaneously. For industrial membrane stacks applied to water desalination, a cell thickness of 0.4-0.6 mm and a flow velocity of about 0.1 m/s seem to be the economically most reasonable design criteria. (Author's abstract)
W88-02435

CURRENT AND LONG TERM CONSIDERATIONS FOR THE APPLICATION OF REVERSE OSMOSIS TECHNOLOGY IN ISRAEL,
Mekoroth Water Co., Tel-Aviv (Israel).
P. Glueckstern.
Desalination DSLNAH, Vol. 58, No. 1, p 69-75, February 1986. 3 tab, 8 ref.

Descriptors: *Reverse osmosis, *Technology, *Water treatment, *Desalination systems, *Design standards, Performance evaluation, Brines, Evaporation, Costs, Israel.

In the past two decades desalting technology has been selectively used to solve water shortage and water quality problems in the more arid regions of Israel. The multi-year experience gained in design, construction and operation with a variety of technologies for desalting of various brackish and seawater feeds will be of great value in coping with the severe problems of water shortage and water quality in Israel. The multi-year research and development program prepared by Mekorot Water Co., aimed to add 50 million cu m per year of desalted water at six sites in Israel using advanced reverse osmosis technology, will also contribute to further improving the economics of desalting saline water. (Author's abstract)
W88-02436

DESALINATION OF HIGH SALINITY BRACKISH WATER -- LOW PRESSURE REVERSE OSMOSIS,
Mekoroth Water Co., Tel-Aviv (Israel).
P. Glueckstern, Y. Kantor, S. Kremen, and M. Wilf.
Desalination DSLNAH, Vol. 58, No. 1, p 55-67, February 1986. 4 fig, 6 tab, 4 ref.

Descriptors: *Reverse osmosis, *Salinity, *Water treatment, *Desalination systems, *Design standards, Performance evaluation, Brines, Evaporation, Costs, Economic aspects.

Most of the hitherto reported applications of low pressure reverse osmosis membranes have been concerned with pilot scale or small size test situations involving feed waters with relatively low levels of dissolved solids (less than 2000 mg/L), with resulting net driving pressures of 14-15 bar (ca. 200 psi) or more. This paper describes the results obtained for thousands of hours of still continuing operation, of a much larger plant currently producing at least 3000 cu m/d (ca. 0.8 MGD) of product. The feed in this case has a dissolved solids content of 6,000-6,500 mg/L at 65% recovery at a feed pressure of less than 14 bar (ca. 195 psi) with a system net driving pressure of no more than 7 bar (95-100 psi). Even though the feed has a significant consumption, using existing pumps, piping, and circuitry is only slightly more than 1 kWh/cu m of product (less than 4 kWh/kgal). Plant performance has been and continues to be level with respect to all parameters including intrinsic productivity, salt passage, differential pressures, etc. It is being monitored, analyzed, and evaluated using specially developed computer software. On the basis of the excellent stable results achieved to date with these newly commercial membranes and elements on a large scale, a number of further performance and cost improvements are being considered for early implementation. (Author's abstract)
W88-02437

PRECIPITATION EQUILIBRIUM DURING EVAPORATION OF WATER CONTAINING HIGH DISSOLVED SALTS,
Calgon Corp., Pittsburgh, PA.
J. S. Gill, and R. G. Varsanik.
Desalination DSLNAH, Vol. 60, No. 1, p 1-8, September 1986. 4 fig, 1 tab, 15 ref.

Descriptors: *Chemical precipitation, *Evaporation, *Desalination, *Water treatment, *Kinetics, *Salts, Solutions, Ions, Minerals, Supersaturation.

The kinetics of mixed precipitates have been studied using an evaporative cycling-up technique. In mixed precipitates with one common scale-forming ion, the effects of one mineral precipitation on the supersaturation, nucleation, and crystal growth of other subsequent precipitates have been discussed. The data indicate that in evaporative systems, precipitation of sparingly soluble minerals is not solely controlled by supersaturation, but also by the time involved in attaining the critical supersaturation. Thermodynamic equilibria should be used with caution for predicting a chemical treatment of systems encountering mixed scales. (Author's abstract)
W88-02443

ANALYSIS OF LAMINAR FLOW PRECIPITATION FOULING ON REVERSE OSMOSIS MEMBRANES,
Technion - Israel Inst. of Tech., Haifa. Dept. of Chemical Engineering.
J. Gilron, and D. Hasson.
Desalination DSLNAH, Vol. 60, No. 1, p 9-24, September 1986. 8 fig, 2 tab, 17 ref.

Descriptors: *Membrane processes, *Reverse osmosis, *Laminar flow, *Chemical precipitation, *Evaporation, *Desalination, *Water treatment, Flow, Kinetics.

Precipitation fouling on reverse osmosis membranes was analyzed by the boundary layer integral method for laminar flow in a parallel plate passage. Flux decline and concentration polarization levels are governed by a complex coupling between precipitation kinetics, mass transfer, and the deposit structure. Precipitation at the membrane relieves the concentration polarization of the precipitating salt. Concentration polarization is also relieved by the flux decline accompanying the increased hydraulic resistance of the growing deposit. As precipitation rate increases with growing concentration polarization, the wall concentration reaches an asymptotic level at which salt convection into the boundary layer is balanced by the rate of precipitation. In the usual case where an inert salt is also present, the concentration polarization of the precipitating salt may pass through a maximum. Permeate flux is reduced by the increasing osmotic pressure of the inert salt, thereby reducing the concentration polarization of the precipitating salt. The analysis stresses the importance of distinguishing between those effects mainly attributable to precipitation kinetics and those which are primarily a function of the deposit structure. Flux decline data alone are inadequate to elucidate kinetic aspects of precipitation fouling phenomena. (Author's abstract)
W88-02444

DEMONSTRATION PLANT FOR SEAWATER DESALINATION BY REVERSE OSMOSIS (RO-2 HOLLOW FIBRE MODULE LINE),
Hager und Elsaesser G.m.b.H., Stuttgart (Germany, F.R.).
K. Marquardt, and R. Nagel.
Desalination DSLNAH, Vol. 60, No. 1, p 25-44, September 1986. 16 fig, 1 tab, 20 ref.

Descriptors: *Membrane processes, *Reverse osmosis, *Evaporation, *Desalination, *Water treatment, Fiber modules, Drinking water.

A reverse osmosis (RO) seawater desalination demonstration plant (3000 cu m/d with three lines) is being operated by Kuwait to investigate the suitability and optimum operating conditions for polyamide hollow fiber compact modules, flat-plate modules, and spiral-wound modules. The plant described herein has hollow fiber modules with one high pressure stage of 56-63 bar operating pressure and salt passage of about 1.5%, and a second desalination stage with an operating pressure of 28 bar. Drinking water is made up as a mixed permeate from the two stages. During the first year, the RO units operated perfectly, and results obtained exceeded the design values. (Author's abstract)
W88-02445

REJECTION SPECTRA OF REVERSE OSMOSIS MEMBRANES DEGRADED BY HYDROLYSIS OR CHLORINE ATTACK,
Louisville Univ., KY. Dept. of Chemical and Environmental Engineering.
J. C. Watters, E. Klein, M. Fleischman, J. S. Roberts, and B. Hall.
Desalination DSLNAH, Vol. 60, No. 2, p 93-110, September 1986. 9 fig, 3 tab, 12 ref.

Descriptors: *Membrane processes, *Reverse osmosis, *Evaporation, *Desalination, *Water treatment, Degradation, Temperature.

Cellulose acetate (CA) and polyamide (PA) membranes were subjected to accelerated degradation for up to 24 h to determine the effects of curing temperature and degradation time on transmembrane flux and on the rejection by the membranes of salts (NaCl and CaCl2), hexose sugars and polysaccharides. Commercial PA membranes, and one set of CA membranes made in the laboratory lost all salt rejection ability after 24 h of degradation but maintained 100% rejection of polysaccharides, and thus still functioned as ultrafilters. A second set of CA membranes was cured at different temperatures. CA membranes annealed at 45 C and 55 C degraded faster than those annealed at 75 C, based on their faster loss of salt rejection ability. This rapid degradation of the membranes annealed at lower temperatures, coupled with their inherent poor initial salt rejection enforces the conclusion that membranes to be used in reverse osmosis applications should not be cured below about 55 C. Based on the study, a simple test procedure is proposed to distinguish between chemical degradation and gross failure in malfunctioning reverse osmosis units. (Author's abstract)
W88-02448

CALCULATION OF STREAM CONCENTRATIONS IN REVERSE OSMOSIS PROCESSES,
Yugoslav Academy of Sciences and Arts, Dubrovnik. Inst. for the Protection of Materials from the Influence of Sea Water and Desalination.
D. Sambrailo, and B. Kunst.
Desalination DSLNAH, Vol. 60, No. 2, p 111-116, September 1986. 3 fig, 18 ref.

Descriptors: *Design equations, *Membrane processes, *Reverse osmosis, *Evaporation, *Desalination, *Water treatment, Brines, Membranes.

A modification of the design equations used for the calculation of expected performance of reverse osmosis units is proposed. The product water and brine concentrations were calculated as functions of the product recovery and a variable salt rejection coefficient of the membrane. The calculated data compare favorably with the experimentally obtained results. (Author's abstract)
W88-02449

TESTING RO DESALINATION AT VERY HIGH RECOVERIES IN THE ARABIAN GULF (GKSS PLATE SYSTEM),
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)
K. Scharff.
Desalination DSLNAH, Vol. 60, No. 2, p 117-133, September 1986. 12 fig, 7 tab, 5 ref.

Descriptors: *Membrane processes, *Reverse osmosis, *Evaporation, *Desalination, *Water treatment, Pilot plants, Microscopy.

By means of a pilot plant, specific energy consumption at different recoveries, and scale limiting recovery at a given pretreatment were measured for a GKSS plate and frame system. Membrane surface investigations for deposits were carried out using a scanning electron microscope. Results of the measurements and examinations are presented and discussed. (Author's abstract)
W88-02450

MALTA SEAWATER RO FACILITY,
Polymetrics, Inc., Sunnyvale, CA.
W. T. Andrews, and R. A. Bergman.
Desalination DSLNAH, Vol. 60, No. 2, p 135-144, September 1986. 9 fig, 3 tab.

Descriptors: *Membrane processes, *Reverse osmosis, *Evaporation, *Desalination, *Water treatment, Costs, Performance evaluation, Design standards, Malta.

The Polymetrics seawater reverse osmosis (RO) facility at Ghar Lapsi, Malta, is one of the largest seawater RO plants in the world, with an installed capacity of 20,000 cu m/d (5.3 U.S. mgd). A second plant, provided under the same contract, has a capacity of 4,500 cu m/d (1.2 U.S. mgd),

utilizing highly brackish feedwater. The plants supply potable water for the island's 350,000 residents and its growing tourist trade. The seawater plant is a single pass design, utilizing DuPont permeators and is the first major installation incorporating energy recovery turbo-pumps. This paper summarizes the plant design, manufacture, assembly, and installation, and also reports up-to-date operation and maintenance data. The operating costs are presented. (See also W88-02452) (Author's abstract)
W88-02451

MALTA SEAWATER RO FACILITY - UPDATE ON THE FIRST TWO YEARS OPERATION,
Polymetrics, Inc., Sunnyvale, CA.
W. T. Andrews.
Desalination DSLNAH, Vol. 60, No. 2, p 145-150, September 1986. 3 fig, 1 ref.

Descriptors: *Membrane processes, *Reverse osmosis, *Evaporation, *Desalination, *Water treatment, Design standards, Costs, Seawater, Malta.

The seawater reverse osmosis (RO) facility at Ghar Lapsi, Malta, is the largest operating seawater RO plant in the world, with an installed capacity of 20,000 cu m/d (5.3 US mgd). This paper summarizes the plant design and the operating and maintenance data for the first 2 1/2 years of operation. The plant has met its production requirements, demonstrating, on a large scale, the reliability of reverse osmosis for seawater desalination. The total cost of water (excluding capital recovery) of approximately $0.62 cu m ($2.35/1000 US gallons), demonstrates the economical production of water by this process. The award of an operation and maintenance contract to an experienced and motivated operations staff has assured a reliable supplement to the water supply of Malta. (See also W88-02451) (Alexander-PTT)
W88-02452

SUPPLY OF DESALTED WATER TO REMOTE ARID ZONES,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Nuclear Engineering.
A. F. Abdul-Fattah.
Desalination DSLNAH, Vol. 60, No. 2, p 151-164, September 1986. 1 fig, 6 tab, 5 ref.

Descriptors: *Cost-benefit analysis, *Water supply, *Evaporation, *Desalination, *Water treatment, Arid regions, Pipelines.

Three options for supply of water from desalination plants to isolated population pockets are considered. Based on cost - benefit analysis the most feasible strategy is selected. The supply systems considered are piping water from large desalination plants, traditional transportation by sea or land-going tankers, and the installation of small solar desalination plants. Small solar powered desalination plants are favored as an optimal strategy considering factors such as continuous supply of potable water. (Author's abstract)
W88-02453

SELECTION OF SOLAR DESALINATION SYSTEM FOR SUPPLY OF WATER IN REMOTE ARID ZONES,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Nuclear Engineering.
A. F. Abdul-Fattah.
Desalination DSLNAH, Vol. 60, No. 2, p 165-189, September 1986. 2 fig, 21 tab, 38 ref.

Descriptors: *Cost-benefit analysis, *Water supply, *Evaporation, *Desalination, *Water treatment, Costs, Arid regions.

Solar desalination is undoubtedly an immediate solution for water problems in remote arid areas. Considering five options of solar desalination systems, an optimal system is selected that meets preset objectives of ease of operability, accessibility for maintenance and failure diagnostic, compatibility with environment, maturity of technology, high availability, capacity factor, recovery and expandability. Solar powered RO systems seem to best meet those objectives. Cost - benefit analysis also shows that such systems may be preferred over alternative systems based on a low cost to benefit ratio. (Author's abstract)
W88-02454

COMPARISON OF VARIOUS DESIGNS OF SOLAR STILLS,
Indian Inst. of Tech., New Delhi. Centre of Energy Studies.
G. N. Tiwari, K. Mukherjee, K. Ashok, and Y. P. Yadav.
Desalination DSLNAH, Vol. 60, No. 2, p 191-202, September 1986. 6 fig, 3 tab, 4 ref.

Descriptors: *Distillation, *Stils, *Solar stills, *Evaporation, *Desalination, *Water treatment, Performance evaluation, Costs, Comparison studies, India.

The design and performance of three single basis solar stills, namely the single slope fiber reinforced plastic (FRP) still, the double slope FRP still and the double slope concrete still are presented. The bacteriological test, test for laboratory use, and tests for physical and chemical properties were also carried out on various distilled water samples. On the basis of the above, and long term performance of these stills under Delhi conditions, the following conclusions were drawn: in winter, the single slope FRP still gives better yield than the double slope stills; in summer, the double slope stills give better yield than the single slope still; the sample of distilled water from the single slope FRP still passes the bacteriological test. (Author's abstract)
W88-02455

FORMULAS FOR CALCULATING THE APPROACH TO EQUILIBRIUM IN OPEN CHANNEL FLASH EVAPORATORS FOR SALINE WATER,
Pennsylvania Univ., Philadelphia. Dept. of Mechanical Engineering and Applied Mechanics.
N. Lior.
Desalination DSLNAH, Vol. 60, No. 3, p 223-249, December 1986. 20 fig, 2 tab, 19 ref.

Descriptors: *Evaporators, *Evaporation, *Desalination, *Water treatment, Seawater, Performance evaluation, Equations.

The evaporator used in multistage flash desalination plants, and considered for open cycle ocean-thermal energy conversion (OTEC) plants is the open-channel type, in which an essentially-horizontal stream of seawater is passed through an open channel in which it is exposed to a pressure lower than the saturation pressure which corresponds to its temperature. This paper reviews the equations used at present to determine the nonequilibrium allowance, which indicates how far from equilibrium the seawater stream is as it leaves the evaporator. Flash evaporation in open channels is used in most of the water desalination plants, and the existing equilibrium equations have been developed for that application. The equations are typically empirical correlations, each developed for one type of geometry and range of parameters. The equations are compared graphically, plotted side-by-side to express nonequilibrium allowance as a function of the major parameters: stage saturation temperature, stage flash-down, flashing seawater flow rate, stage length, and flashing seawater depth. It was found for water desalination applications that there exists a large spread between the non-equilibrium fraction values calculated by the different equations, of about one order of magnitude. The situation is even worse for OTEC conditions. Consequently, it was concluded that no general method exists for the adequately accurate prediction of the approach to equilibrium of flashing free stream channel flows. (Author's abstract)
W88-02456

MULTI-EFFECT BOILING DESALTING SYSTEM AND ITS COMPARISON WITH THE MULTI-STAGE FLASH SYSTEM,
Kuwait Univ., Safat. Dept. of Mechanical Engineering.
M. A. Darwish, and A. A. El-Hadik.
Desalination DSLNAH, Vol. 60, No. 3, p 251-265, December 1986. 8 fig, 9 ref.

Descriptors: *Thermodynamics, *Evaporation, *Desalination, *Water treatment, Performance evaluation, Design standards.

The basic characteristics of the multi-effect boiling (MEB) desalination system are presented. Recent developments are considered, and a thermodynamic analysis and evaluation of the heat transfer areas required for the MEB system are given. In comparing the heat transfer areas, water pretreatment and salt concentration, pumping power requirement and stability of the MEB and multi-stage flash (MSF) systems, MEB seems to have definite advantages over MSF. However, in the absence of well-proven large capacity MEB units, and in view of the good experience with and reliability of MSF systems, large producers of desalted water favor continued installation of MSF systems. (Author's abstract)
W88-02457

3B. Water Yield Improvement

COLORADO RIVER AUGMENTATION DEMONSTRATION PROGRAM.
Bureau of Reclamation, Montrose, CO.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB87-200044, A03 in paper copy, A01 in microfiche. Technical Report January 1983-March 1985. May 1986. 42 p, 20 fig, 3 tab, 33 ref.

Descriptors: *Colorado River Augmentation Program, *Weather modification, *Precipitation, Cloud seeding, Spatial distribution, Temporal distribution, Supercooled liquid water, Ice, Meteorology, Wind.

Wintertime field investigations of clouds and precipitation were conducted from January 1983 through March 1985 over the Grand Mesa of western Colorado. Resulting analyses are discussed including spatial and temporal distributions of SLW (supercooled liquid water), precipitation characteristics, airborne and ground-based ice particle observations, and the meteorological conditions associated with these cloud and precipitation phenomena. It was observed that SLW frequently occurred over the Mesa. The large number of hours with limited amounts contributed to a significant SLW flux. The SLW often formed over the windward slopes, persisted over the top, and rapidly evaporated to the lee of the barrier. Nature was inefficient in converting the SLW into precipitation in many cases. The Mesa created distortions in the free air flow. The wind in the lowest 500 m was slowed down over the windward slope and, for southwesterly or northwesterly directions, was turned approximately perpendicular to the barrier axis. The wind then accelerated over the lee slopes. A number of instrumentation intercomparisons are described. Systems include microwave radiometers, icing detectors, precipitation gauges, and radars used for cloud top observations. (Author's abstract)
W88-01609

METHODS OF LAND AND WATER CONSERVATION IN THE WUDING RIVER BASIN,
Ministry of Water Resources and Electric Power, Beijing (China).
G. Shiyang, and M. Jinze.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 81-89, 4 fig, 1 tab, 1 ref.

Descriptors: *Water conservation, *Wuding River, *River basins, *River basin development, *Soil conservation, *China, Water resources development, Land management, Sediments, Vegetation, Erosion, Dams, Watersheds, Reservoirs, Land use.

The work of harnessing the Wuding river has lasted for almost 30 years. The natural conditions of its subregions differ from each other calling for

unique strategy and the selection of regionally adapted land and water conservation measures. The wind drift sand area primarily needs protection from wind erosion, measures to transform sand dunes into cultivable flat land, and reservoirs to store flood water. The river source area needs check dams in the deep gullies to trap sediment, improve vegetation cover, and river dams for sediment retention and water storage. The gullied hilly loess area, finally, consists of many small gully watersheds and is therefore the most difficult to manage. (See also W88-02227) (Author's abstract)
W88-02235

SOIL AND WATER CONSERVATION ON THE CHINESE LOESS PLATEAU - THE EXAMPLE OF THE XIO SHI GUO BRIGADE,
Royal Inst. of Tech., Stockholm (Sweden). Institutionen foer Kulturteknik.
J.-E. Gustafsson.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 91-97, 2 fig, 4 tab, 4 ref.

Descriptors: *Water conservation, *Soil conservation, *China, *Loess, *Xio Shi Guo Brigade, *Yellow River, River basins, Gullies, Dams, Groundwater, Irrigation, Wells, Land use, Land tenure, Population density, Social aspects.

The comprehensive planning of land and water resources in the Yellow River basin is reviewed. The soil and water conservation work in the Xio Shi Guo Brigade on the Chinese Loess Plateau is presented as an example. The Xio Shi Guo Brigade is situated within the gully hilly area about 40 km northeast of Yanan City. All the land is located along a big gully and five smaller gullies, which alleviate the conservation works. The brigade has 154 inhabitants, living in 34 households. The labor force numbers 59 people. The brigade started to build the first siltation dams in 1956. In the beginning, the first dams were destroyed by heavy rainstorms, because no spillways were built. The brigade has used labor to build 33 dams and create 5 ha of new dam land. There are series of dams in each gully, which are needed in order to control the storm floods. The brigade has also dug a groundwater well with a depth of 10 m and a diameter at the bottom of 3 m. This well could supply pumped irrigation water to 1/3 ha of dam land each time. During the irrigation season the well is recharged with groundwater within one day. The constructing of high yielding new dam land has created a favorable situation for a better land use. The experience of Xio Shiu Guo Brigade is successful as almost all soil and water has been conserved within the gullies. A cooperative ownership approach toward land and water resources development has had many advantages. First, in the Xio Shi Guo Brigade, the arable area/household is only 0.8 ha. It is not likely that a rational control and management of resources could be achieved by a system of small peasant land ownership under such circumstances of land scarcity. Only the cooperative ownership approach could give a solution to the problem of scale economy in agricultural production. Second, the cooperative system of investment allocation and income distribution has transferred the element of risk in agricultural production from the individual peasant to the cooperative unit. Third, the cooperative village framework has provided the needed linkage between governmental authorities centralized planning and economic guidance. Fourth, the cooperative organization has furnished the village level with a functional democracy, which has promoted the peasants grass-root participation in planning, implementation and management. (See also W88-02227) (Lantz-PTT)
W88-02236

3C. Use Of Water Of Impaired Quality

AGRICULTURAL APPLICATION OF SEWAGE SLUDGE,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5E.
W88-01508

LOW-RATE CROPLAND APPLICATION: A CASE HISTORY IN JACKSON, MICHIGAN,
Jackson City Waste Water Treatment Plant, MI.
For primary bibliographic entry see Field 5E.
W88-01511

MINE WATER - A RESOURCE FOR TRANSPORTATION OF ORES FROM UNDERGROUND MINES,
Luleaa Univ. (Sweden). Div. of Water Resources Engineering.
A. Sellgren.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 1027-1037, 9 fig, 6 ref.

Descriptors: *Mine drainage, *Groundwater management, Costs, Dewatering, Energy.

In underground mining, a hydraulic hoisting system can increase the hoisting capacity without necessitating the sinking of new shafts. There is generally a considerable inflow of groundwater which has to be pumped out. When the mine dewatering installations are integrated with a hydraulic hoisting system, the cost of power needed to pump out the groundwater is excluded from the costs of hoisting, compared with other modes of transporting the solids to the surface. Different hydraulic systems are analyzed and leading parameters such as total energy consumption and underground water availability, are related systematically to representative solid to water mass ratios and pump efficiencies. The economical effectiveness of integrating the mine dewatering and the hydraulic hoisting system is demonstrated, and finally some schematic layouts of applications are presented. (See also W88-01554) (Author's abstract)
W88-01589

STUDY OF SALINE WATER USE AT THE ETIWANDA GENERATING STATION,
For primary bibliographic entry see Field 3A.
W88-01611

PREFERENCE OF THE GREEN PEACH APHID, MYZUS PERSICAE, FOR PLANTS GROWN IN SEWAGE SLUDGES,
Cornell Univ., Ithaca, NY. Dept. of Entomology.
T. W. Culliney, and D. Pimentel.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 2, p 257-263, August 1987. 2 fig, 1 tab, 26 ref.

Descriptors: *Water pollution effects, *Land disposal, *Aphids, *Sludge utilization, Sludge, Insect behavior, Insects, Leaves, Insect settling behavior, Agriculture, Agricultural chemicals, Municipal wastewater, Urban wastewater.

Marked reduction was previously demonstrated in fecundity and survival of green peach aphids Myzus persicae on collard plants growing in soil treated with chemically contaminated sludge as compared with aphids on plants growing either in soil treated with uncontaminated sludge or soil conventionally fertilized. Reduced plant growth and increased restlessness in aphids in the contaminated sludge treatment were also observed previously. Therefore, the influence of sludge contaminants on aphid settling behavior as indicated by differential preference of M. persicae for leaves of its collard host grown under different soil conditions was investigated. Differences in numbers of aphids settling on leaves among the treatment discs were significant at 24 hours and 72 hours, but not significant at 48 hours. Fewest aphids colonized leaf discs grown in unfertilized soil, whereas discs from plants grown in commercially fertilized soil were settled upon by a relatively high number of aphids. Both treatments exhibited fairly stable numbers of settled aphids over the entire 72 hour period. After 24 hours many aphids had settled on leaves of plants treated with sludge from a small town, but the number declined steadily over the next 48 hours. On leaf discs from plants treated with the sludge from a large industrial city the trend was reversed; most aphids settled on these by the culmination of the study. (Wood-PTT)
W88-01724

OBSERVATIONS ON WATER POTENTIAL AND DROUGHT RESISTANCE OF TREES AND SHRUBS AFTER A PERIOD OF SUMMER DROUGHT AROUND DUNEDIN, NEW ZEALAND,
Otago Univ., Dunedin (New Zealand). Dept. of Botany.
For primary bibliographic entry see Field 2I.
W88-01806

APPLICATION OF SOLAR ENERGY IN WATER REUSE,
Banaras Hindu Univ., Varanasi (India). Pollution Research Lab.
For primary bibliographic entry see Field 5D.
W88-01807

ANAEROBIC METABOLISM ENZYMES AS MARKERS OF FLOODING STRESS IN MAIZE SEEDS,
Agricultural Research Service, Columbus, OH.
For primary bibliographic entry see Field 2I.
W88-01998

WATER QUALITY ASPECTS OF ARTIFICIAL AQUIFER RECHARGE WITH TREATED WASTEWATER,
University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Programme.
For primary bibliographic entry see Field 5G.
W88-02092

INVESTIGATIONS INTO THE FEASIBILITY OF A DUCK-FISH-VEGETABLE INTEGRATED AGRICULTURE-AQUACULTURE SYSTEM FOR DEVELOPING AREAS IN SOUTH AFRICA,
Transkei Univ., Umtata (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 8I.
W88-02093

FULL-SCALE DEMONSTRATION OF TEXTILE DYE WASTEWATER REUSE,
Sverdrup and Parcel and Associates, Inc., St. Louis, MO.
For primary bibliographic entry see Field 5D.
W88-02150

RECOVERY OF WASTE BRINES FOR HIGHWAY APPLICATIONS,
West Virginia Univ., Morgantown. Dept. of Civil Engineering.
W. A. Sack, R. W. Eck, and C. R. Romano.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 213-223, 8 tab, 15 ref.

Descriptors: *Brines, *Industrial wastes, *Highways, *West Virginia, Oil wastes, Dissolved solids, Chlorides, Sodium, Calcium, Zinc, Lead, Barium, Chromium.

Waste liquids arising from oil and gas production may be divided into three categories: drilling fluids and muds, chemical treatment fluids and produced brines. This paper focuses on the quality and quantity of produced brines and the potential for recovery of these waste fluids for use in highway applications. Sampling and analyses of produced brines from 13 counties representing 8 different geological formations indicates that there are a significant number of West Virginia brines of suitable quality for use in highway application. Total dissolved solids level of the 49 samples collected ranged from 90,400 to 323,700 mg/L with a mean of 218,600 mg/L. Brine strength generally increased with depth of formation. The average values of the

major constituents found were as follows: chloride - 128,600 mg/L, sodium - 52,700 mg/L, calcium - 31,300 mg/L. Using RCRA limits as a guide, somewhat elevated levels of lead and cadmium were found in a small number of cases and high barium levels were present in one field. Evaluation of conventionally used dry salt deicing agents also showed significant levels of certain trace constituents. Brines were generally higher in zinc, lead and barium while the dry agents contained more chrome and cadmium. The dominant factor contributing to variation in brine quality was the parent formation while zonal quality differences within a given formation were much less dramatic. Samples taken at greater distances from the same formation also seemed to show increased variability in quality. Brine sampled from a single well over the sampling period showed little quality variation. (See also W88-02132) (Lantz-PTT)
W88-02155

SOME EXPERIENCE IN SOFTENING THE OILFIELD WATERS BY ION EXCHANGE FOR STEAMFLOOD OPERATION,
Koomey, Inc., Brookshire, TX. Engineering Dept.
For primary bibliographic entry see Field 5D.
W88-02156

EVALUATION OF IRRIGATION MANAGEMENT PROCEDURES FOR GEOTHERMAL EFFLUENT,
Idaho Water Resources Research Inst., Moscow.
C. E. Brockway, C. W. Robbins, C. W. Robison, and G. S. Johnson.
Available from the National Technical Information Service, Springfield, Virginia. 22161 as DE84-015188. Report No. DOE/ID/12167–T1, June 1984. 47 p, 17 fig, 9 tab, 14 ref. DOE Contract No. DE-AS07-801D12167.

Descriptors: *Water pollution effects, *Wastewater disposal, *Industrial wastes, *Raft River, *Thermal powerplants, *Wastewater irrigation, Thermal pollution, Aquifers, Powerplants, Salinity, Agriculture, Irrigation, Fluoride, Soil contamination.

An investigation was conducted to determine the feasibility of geothermal powerplant effluent disposal by surface irrigation and the resulting impact on the shallow aquifer. The study was conducted at the Raft River Experimental Geothermal Power Plant site near Malta, Idaho and at the Snake River Conservation Research center with soils and effluent obtained from the geothermal powerplant site. The conclusions of the investigation were: (1) Salinity hazard to the shallow aquifer is minimized by high-rate irrigation of previously irrigated lands due to the high amounts of soluble salts found int he native soils; (2) Irrigation disposal of effluent will cause little if any fluoride contamination of the shallow aquifer; (3) The irrigation method best suited for disposal is surface irrigation with borders. The irrigation system will experience problems with cold weather operation. Crop emergence will be hindered by border irrigation; (4) Recommended cropping systems on disposal lands are grain and forage crops, providing the portion harvested did not have contact with the effluent; and (5) Two mechanisms in the soil were apparently removing fluoride from the effluent. One mechanism was identified (fluorite precipitation) and one was not. Further study is needed to determine the other mechanism. (Author's abstract)
W88-02268

EFFLUENT QUALITY VARIATIONS IN RELATION TO WATER REUSE FOR IRRIGATION,
Kuwait Univ., Safat. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W88-02401

PHYSIOLOGICAL RESPONSES OF SOYBEAN (GLYCINE MAX L. MERR) TO SIMULATED ACID RAIN AND AMBIENT OZONE IN THE FIELD,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W88-02473

3D. Conservation In Domestic and Municipal Use

RATIONAL PROGRAM TO CONTROL UNACCOUNTED-FOR WATER,
Greeley and Hansen, Chicago, IL.
R. Zimmerman, F. Maisch, and P. Pantumsinchai.
Public Works PUWOAH, Vol. 118, No. 7, p 50-53, July 1987. 1 fig, 1 tab.

Descriptors: *Drinking water, *Costs, *Water rates, *Water management, Water metering, Water delivery, Utilities, Leakage, Future planning.

Unaccounted-for water is the amount of potable water produced and not accounted for in a billing system. It includes known nonmetered uses, such as firefighting and hydrant flushing, and unknown uses. A comprehensive program was developed to help water utilities recover unaccounted-for water and, consequently, lost revenue. It is currently being successfully implemented in Medellin, Colombia, a city of over 1.8 million people. The program consists of six major elements: user meter systems, master meter systems, leak detection, quality control, control of system pressures, and system data collection. Each of these aspects is discussed. (Airone-PTT)
W88-01820

SOCIO-TECHNOLOGICAL ASPECTS OF AUTOMATION IN PUBLIC WORKS ACTIVITIES,
Associate Quad Consultants, Visalia, CA.
For primary bibliographic entry see Field 6B.
W88-01957

WATER CONSERVATION AND MANAGEMENT IN BARROW, ALASKA,
Northern Testing Lab., Inc., Fairbanks, AK.
M. R. Pollen.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 3, p 26-34, March 1987. 6 fig, 2 tab, 27 ref.

Descriptors: *Water conservation, *Municipal water management, *Water treatment facilities, *Barrow, Alaska, *Reverse osmosis, *Desalination, *Water quality management, Membrane processes, Chemical treatment, Water storage, Water distribution, Water use, Planning, Conservation, Water management, Arctic, Potable water, Water treatment, Reservoirs, Dams, Heat exchangers, Aerators, Flocculation, Polymers, Filtration.

Barrow Utilities and Electric Coop Inc. (BUECI) operates the northernmost potable water treatment system in the United States, treating and distributing water to the arctic community of Barrow, Alaska. BUECI uses a desalination plant with a complex pretreatment system to correct a bewildering array of water quality problems under severe environmental constraints, specifically the proximity of the ocean to the nearby shore lakes and lagoons, resulting in much of the 'fresh' water in the vicinity being contaminated with salt. The plant incorporates an upgraded, elaborate reverse osmosis desalination pretreatment system consisting of the following equipment: well house and heat exchanger; aeration tank and aluminum addition; polymer addition and precipitator; gravity and micron filters; reverse osmosis desalination; chemical addition; and storage and distribution. Water use and conservation is discussed, including systems using different grades of water, systems that do not use water, and minimal water use equipment. Future water management is considered, including possible means of supplementing the water supply. (Doria-PTT)
W88-02312

WATER CONSERVING LANDSCAPES SHOW IMPRESSIVE SAVINGS,
North Marin County Water District, Novato, CA.
J. O. Nelson.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 3, p 35-42, March 1987. 8 fig, 4 tab.

Descriptors: *Water conservation, *Landscaping, *Cost analysis, *California, *Costs, *Project planning, Planning, Fertilizers, Fuel, Herbicides, Agricultural chemicals, Water costs, Operating costs, Irrigation, Grasses, Turf grasses, Mathematical analysis, Regression analysis, Analysis of variance, Water use, Economic aspects.

A research project was conducted by the North Marin (CA) Water District to compare the use of key factors in traditional projects with those in water conserving projects on a monthly basis over the entire irrigation season. Factors included outside water, landscape labor, fertilizer, fuel, and herbicide. Microclimate data were collected to ensure the validity of the comparisons. The sample consisted of seven planned unit developments consisting of 548 dwelling units, all with mature landscapes, and was divided into two segments: traditionally landscaped projects and projects that met specific design criteria for water conservation. Results were examined by variance-regression analysis. It was concluded that, although the dollar savings attributed to fuel and herbicide were small, considerable savings could be achieved by the use of a water-conserving landscape design. An annual savings of $75 per dwelling unit is possible in a condominium or townhouse development. The reduction in water and labor costs accounted for more than 80% of the total savings. A strong correlation was found between the perimeter of the turf and water use, indicating that turf perimeter may be the best parameter for defining a water-conserving landscape. (Author's abstract)
W88-02313

REFORM IN COSTING AND PRICING WATER,
West Virginia Univ., Morgantown. Coll. of Business and Economics.
For primary bibliographic entry see Field 6C.
W88-02314

PUBLIC ATTITUDES TOWARD WATER CONSERVATION,
Colorado Univ. at Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
J. E. Flack, and J. Greenberg.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 3, p 46-51, March 1987. 3 fig, 12 tab, 8 ref.

Descriptors: *Water conservation, *Public opinion, *Attitudes, *Social aspects, *Economic aspects, *Colorado, *Surveys, Public policy, Conservation, Prices, Pricing, Water use, Water reuse, Wastewater renovation, Water supply development, Water resources development, Drinking water, Landscaping.

Consumer attitudes toward water conservation were surveyed in seven northeastern Colorado communities to determine whether relationships exist between (1) attitudes and type of community or (2) attitudes and socioeconomic variables. The water conservation alternatives presented included metering, price increases, restrictions on water use, restrictions on lawn size, controls on population growth, and reuse of treated wastewater for potable purposes. Preferences for development of additional water supplies were also included in the survey. All but one of the conservation alternatives (reuse for drinking purposes) were favored by more than half of the respondents. Consumers in communities with lawn watering restrictions were more willing to install water-saving devices or to change landscaping than were consumers in unrestricted communities. Respondents who were metered strongly favored meters, and flat-rate customers preferred the flat rate. Metered users favored price increases, whereas flat-rate users did not. Restrictions on population growth were preferred more strongly by rural and flat-rate consumers than by urban and metered consumers. Respondents with less than a high school education or earning incomes of less than $15,000 per year more often opposed the various water conservation alternatives. Retired or disabled persons did

not approve of such alternatives as prices increases or installation of water-saving devices. (Author's abstract)
W88-02315

EFFECTIVENESS OF RESIDENTIAL WATER CONSERVATION MEASURES,
Brown and Caldwell, Walnut Creek, CA.
W. O. Maddaus.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 3, p 52-58, March 1987. 5 fig, 7 tab, 13 ref. HUD Contract H-5230.

Descriptors: *Water conservation, *Metropolitan water management, *Planning, *Benefits, *Prediction, *Cost analysis, Conservation, Water management, Economic aspects, Maintenance, Water use.

The Department of Housing and Urban Development conducted a survey on demonstration projects to document the water saving in homes of people who installed water-conserving fixtures and devices. These included low-flush toilets and showerheads, retrofit of toilets and showerheads, very-low-flow fixtures, adjustment of water pressure, and installation of water meters. More than 200 households participated in the survey nationwide. Water savings were documented from these measures as well as from repair of leaking fixtures. It is concluded that water pressure influences water use, and that a reduction of 30-40 psi results in a 3-6% reduction in water use. While it may not be practical to reduce water pressure in existing developed areas, water can be saved by limiting water pressure in new developments to 50-60 psi where practical. Reducing water pressure also saves operating costs and may decrease the likelihood of leaks. (Author's abstract)
W88-02316

SOCIOECONOMIC FACTORS AFFECTING WATER CONSERVATION IN SOUTHERN TEXAS,
Washington State Univ., Pullman. Office of Applied Energy Studies.
D. Olsen, and A. L. Highstreet.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 3, p 59-68, March 1987. 9 tab, 13 ref.

Descriptors: *Social aspects, *Economic aspects, *Water conservation, *Texas, *Education, *Surveys, *Attitudes, Conservation, Public opinion, Water resources development, Planning, Project planning, Public policy, Water policy, Institutions.

The Edwards Underground Water District and the city of San Antonio, TX conducted a regionwide conservation program during the summer and fall of 1984. The program's goals were to educate the public about the potential water scarcity problem and to promote largely voluntary conservation measures. To evaluate acceptance of the program by the public, a regional survey was administered that included questions regarding knowledge about and attitudes toward water resources development and conservation, the types of information sources people use and prefer to use about conservation practices, and the conservation measures people actually implemented under the impetus of the program. Some considerations relevant to conservation programs throughout the state and elsewhere are discussed. Many institutional and economic factors affect water conservation policy in general, and it was concluded that water conservation must be assigned full resource status in order to implement effective institutional policy options. (Author's abstract)
W88-02317

WATER UTILITY MAKES USE OF NATIONAL WEATHER SERVICE RADAR,
Washington Suburban Sanitary Commission, Hyattsville, MD.
For primary bibliographic entry see Field 7B.
W88-02393

3E. Conservation In Industry

PROPERTIES OF HYDRAULIC STOWING MATERIAL WITH PARTICULAR REFERENCE TO DRAINAGE REQUIREMENTS,
Technical Univ. of Istanbul (Turkey). Faculty of Mining.
E. Arioglu, and A. Yuksel.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 897-906, 3 fig, 3 tab, 12 ref.

Descriptors: *Hydraulic mining, *Drainage, *Industrial water, Permeability, Groundwater movement, Water storage.

In hydraulic mining practice, a great deal of effort has been expended in trying to develop drainage systems for rapid and safe water removal. One of the fundamental requirements of an effective drainage system is that the permeability of the waste material must be equal or greater than the mining rate to be employed in the project. Otherwise the use of decant towers can become necessary for removal of excess water. A study was conducted to improve estimates of drainage using a design method based on results of experimental investigations. A nomogram can be used for directly determining the required permeability depending upon design parameters such as face length, pour area, seam thickness and mining rate. (See also W88-01554) (Lantz-PTT)
W88-01579

PLATING WASTE TREATMENT,
For primary bibliographic entry see Field 5D.
W88-01653

SIMULATION MODEL OF COMPETITION FOR WATER RESOURCES AMONG INDUSTRIES IN A RIVER BASIN,
Washington Univ., Seattle. Dept. of Geography.
For primary bibliographic entry see Field 6D.
W88-01866

3F. Conservation In Agriculture

ERODIBLE LAND AND STATE WATER QUALITY PROGRAMS: A LINKAGE,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 5G.
W88-01883

REGIONAL ECONOMIC GROWTH FROM IRRIGATION DEVELOPMENT: EVIDENCE FROM NORTHERN HIGH-PLAINS OGALLALA GROUNDWATER RESOURCE,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Natural Resource Economics.
For primary bibliographic entry see Field 6D.
W88-01911

PHYSIOLOGICAL RESPONSES OF COTTON TO A SINGLE WATERLOGGING AT HIGH AND LOW N-LEVELS,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
W. S. Meyer, D. C. Reicosky, H. D. Barrs, and R. C. G. Smith.
Plant and Soil PLSOA2, Vol. 102, No. 2, p 161-170, 1987. 6 fig, 4 tab, 27 ref.

Descriptors: *Cotton, *Plant physiology, *Irrigation practices, *Flood irrigation, *Irrigation effects, Nitrogen, Oxygen, Temperature, Photosynthesis, Flooding, Plant stress, Plant growth.

Surface-irrigated cotton (Gossypium hirsutum L.) grown on slowly draining clay soil is subjected to short term periods of waterlogging at each irrigation which generally results in reduced productivity. The sequence of above- and below-ground plant responses to transient waterlogging and the role of N availability in modifying the immediate responses were studied. Lysimeters of Marah clay loam (a Natrustalf) were instrumented to monitor soil and plant responses to a 7-day waterlogging event beginning 67 days after sowing. Cotton ('Deltapine 61') plants (8 per lysimeter) were grown with two levels of added N (300 kg/ha and 30 kg/ha) and two irrigation treatments (flooded and control). Measured soil-O2 levels decreased rapidly upon surface flooding because water displaced air and root zone respiration consumed O2. The rate of O2 consumption was 2.7 times greater in the high-N treatment than the low-N treatment. This difference was associated with a 1.8 fold difference in numbers of observed roots. Root growth was only slightly affected by flooding. Leaf growth decreased by 28%, foliage temperature increased 2.3% and apparent photosynthesis decreased by 16%. It is suggested that flooding reduced photosynthetic activity within 2 days while other stress symptoms became apparent after about 6 days. Although this stress was reflected in a trend for decreased plant productivity, the effect of flooding on boll dry mass at harvest was not significant at the level of replication. The single waterlogging did not cause yield reductions comparable to those observed elsewhere when several waterlogging events were imposed. (Author's abstract)
W88-01992

EFFECT OF TRICKLE FERTIGATION WITH THREE FORMS OF NITROGEN ON SOIL PH, LEVELS OF EXTRACTABLE NUTRIENTS BELOW THE EMITTER AND PLANT GROWTH,
Ministry of Agriculture and Fisheries, Canterbury (New Zealand).Agricultural Research Div.
R. J. Haynes, and R. S. Swift.
Plant and Soil PLSOA2, Vol. 102, No. 2, p 211-221, 1987. 5 fig, 3 tab, 25 ref.

Descriptors: *Trickle irrigation, *Fertilizers, *Nitrogen, *Nutrients, *Irrigation effects, Hydrogen ion concentration, Soil properties, Plant growth, Calcium nitrate, Urea, Ammonium sulfate, Irrigation, Acidification, Crop yield, Zucchini.

The effects of application of nitrogen as calcium nitrate, urea or ammonium sulfate at two rates through the trickle irrigation system on pH and nutrient status of the wetted volume of soil below the emitters and on growth and nutrition of courgette (zucchini) plants (Cucurbita pepo L.) was investigated. Soil acidification, caused by nitrification, occurred to a large extent in the volume of soil immediately below the emitters in the urea and ammonium sulfate than urea. A significant amount of applied urea appeared to move through the soil as urea and consequently, at the same rate of N addition, levels of ammonium were lower directly below the emitter and those of nitrate were higher further away from the emitters for the urea than ammonium sulfate treatments. Soil acidification below the emitters resulted in significant decreases in levels of exchangeable Ca, Mg and K and increases in levels of exchangeable Al, EDTA-extractable Fe, Mn, Zn and Cu and bicarbonate-extractable P. Vegetative growth and harvestable yields of courgettes were increased by both irrigation and nitrogen applications. Vegetative growth was generally greater at the low rate of N addition than at the high one and generally followed the order calcium nitrate > urea > ammonium sulfate. However, fruit yields followed the order urea > ammonium sulfate > calcium nitrate and were larger at the high rate of N for urea and ammonium sulfate treatments and unaffected by rate for the calcium nitrate treatments. It is suggested that with fertigation, the form of applied N can have significant physiological effects of plant growth and yields because N may be applied into the root zone on numerous occasions during the growing season. (Author's abstract)
W88-01993

SOIL AND WATER CONSERVATION ON THE CHINESE LOESS PLATEAU - THE EXAMPLE OF THE XIO SHI GUO BRIGADE,
Royal Inst. of Tech., Stockholm (Sweden). Institutionen foer Kulturteknik.

For primary bibliographic entry see Field 3B.
W88-02236

CATCHMENT ECOSYSTEMS AND VILLAGE TANK CASCADES IN THE DRY ZONE OF SRI LANKA: A TIME-TESTED SYSTEM OF LAND AND WATER RESOURCE MANAGEMENT,
Sri Lanka Univ., Peradeniya. Dept. of Geography.
C.M. M. Bandara.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 99-113, 5 fig, 4 tab, 20 ref.

Descriptors: *Catchment areas, *Ecosystems, *Villages, *Tank cascades, *Sri Lanka, *Land management, *Water conservation, Water resources development, Irrigation practices, River basin development, Surface waters, Water supply.

The salient features of the traditional irrigation systems, particularly those related to tank cascades in the Dry Zone of Sri Lanka, are analyzed with a view to understand the principles of resource management that supported these irrigation technologies to perpetuate over long periods of history, often running back to twenty centuries. The most conspicuous characteristic of these traditional irrigation systems is that they are organized within natural drainage basins in the Dry Zone landscape. Thus, in certain ways these miniature catchment systems may be taken to represent a microcosm of larger river basin systems in Sri Lanka and possibly in other parts of the world. Ecologically, the cascade system appears to be a logical response to the challenges posed by the natural environment in the Dry Zone. Water is the most scare resource in this environment and its rational use formed the basis of all dominant human activities. In an environmental setting where groundwater resources are relatively limited, it is natural that all the attention is focused on surface waters. The management of surface water resources in a cascade is accomplished within the framework of the natural drainage basin. In a climate of seasonal water shortage and occasional water surplus, the development of small village tank systems appears to have been the best answer. Once a system of storage reservoirs is established, a host of microclimatic, hydrological, ecological and socio-cultural factors became the determinants of its success. The preservation of the forest cover in the watershed areas, thus became part of the water conservation strategy. (See also W88-02227) (Lantz-PTT)
W88-02237

CONTROL AND MANAGEMENT OF LAND USE AND WATER RESOURCES OF BHAVANI RIVER BASIN IN TAMIL NADU, INDIA,
Tamil Nadu Agricultural Univ., Coimbatore (India). Water Technology Centre.
R. K. Sivanappan.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 115-122, 2 fig.

Descriptors: *Water conservation, *Land use, *Water resources development, *River basins, *India, *Bhavani River, *Aquifers, Tamil Nadu, Surface water, Water management, Water supply, Irrigation, Seasonal variation, Monsoon, Groundwater, Seepage.

Bhavani River is one of the important tributaries of the River Cauvery in south India. The river originates in the adjoining Silent Valley in Kerala State, passes through Nilgiris hills and joins Cauvery at a place called Bhavani in Tamil Nadu. The total drainage area (basin) is 6730 sq km. The tributaries for the river are Pykara, Siruvani, Kundah, Coonoor and Moyar. The basin receives rain from southwest and northeast monsoons. The lower Bhavani reservoir constructed across the river, provides a storage capacity of 906 million cu m to irrigate about 84,000 ha. In addition, there are many small reservoirs constructed in hills to store about 473 million cu m which are used for hydro power generation which is about 50% of the hydro power production in the State. Water management is a complex problem in this region in view of the fact that it involves numerous farmers and various agencies in the irrigation projects. Therefore, it is necessary to have a Farmer's Association involving the representative farmers and various Governmental agencies responsible for the delivery of water, giving inputs and advice for the agricultural production. The following alternatives are suggested for better water management practices in Lower Bhavani Project: (1) The entire ayacut can be supplied with water at 50% of the present quantity which is supplied to half of the area in alternate years. This would enable the farmer to economically utilize the water, develop underground water resources and to adopt conjunctive water use; and (2) An alternative to No. 1 above, which may be considered is the present system of water distribution to an irrigated crop from August to December to the same field could be changed as follows: Water supply to a field can be started in August. A wet crop can be raised between August and December and the same farmer can go for an irrigated dry crop like groundnut from January to April. Water shall be supplied to the same field from January to April also, but at a reduced quantity. (See also W88-02227) (Lantz-PTT)
W88-02238

REFORM IN COSTING AND PRICING WATER,
West Virginia Univ., Morgantown. Coll. of Business and Economics.
For primary bibliographic entry see Field 6C.
W88-02314

USING CROP YIELD AND EVAPOTRANSPIRATION RELATIONS FOR REGIONAL WATER REQUIREMENT ESTIMATION,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2D.
W88-02382

MANAGING ROTATIONAL CANAL WATER SUPPLIES ON THE FARM,
Central Soil Salinity Research Inst., Karnal (India). Div. of Agricultural Engineering.
N. K. Tyagi.
Water Resources Bulletin WARBAQ, Vol. 23, No. 3, p 455-462, June 1987. 5 fig, 3 tab, 10 ref.

Descriptors: *Water management, *Irrigation practices, *Evapotranspiration, *Crop yield, *Costs, India, Food crops, Agriculture, Planning, Optimization, Irrigation.

A procedure to determine optimal irrigation scheduling strategies under rotational water delivery systems is presented. The methodology involves integration of water delivery amount and frequency, irrigation management strategies, evapotranspiration sequences and crop-evapotranspiration-production functions to arrive at an optimal irrigation strategy. Application of the methodology to a farm in the service area of Western Yamuna Canal (India) where a two-stage system of rotation, one among the irrigation channels and the other among the farmers, is in vogue, reveals that maximum production is obtained with water application in a rotational manner (RI) rather than with irrigation in every or alternate supply periods. Increase in mean water supply which can be effected through improvement in on-farm conveyance and application systems, has a greater effect on yield than decrease in variance of the supply. Benefit cost analyses indicates that precision land leveling is more cost effective in increasing water supply as compared to water-course lining. (Author's abstract)
W88-02384

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

THIRD UNITED STATES - THE NETHERLANDS MEETING ON DREDGING AND RELATED TECHNOLOGY.
For primary bibliographic entry see Field 5G.
W88-01522

FEASIBILITY OF ASSIGNING A PROBABILITY TO THE PROBABLE MAXIMUM FLOOD.
Interagency Advisory Committee on Water Data, Reston, VA. Hydrology Subcommittee.
For primary bibliographic entry see Field 2E.
W88-01612

DEVELOPMENT OF AN EXPERT SYSTEM FOR THE ANALYSIS OF URBAN DRAINAGE USING 'SWMM' (STORM WATER MANAGEMENT MODEL),
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 6A.
W88-01759

STATISTICAL EVALUATION OF DRAINAGE TREATMENTS IN SIMPLE FIELD TRIALS WITH SPECIAL REFERENCE TO FORMER OPENCAST COAL MINING LAND,
University Coll. of Wales, Llanelly. Field Lab.
For primary bibliographic entry see Field 2G.
W88-01923

FIELD DRAINAGE EXPERIMENTS AND DESIGN ON FORMER OPENCAST COAL MINING LAND,
University Coll. of Wales, Llanelly. Field Lab.
For primary bibliographic entry see Field 2G.
W88-01924

SHORT-RANGE RUNOFF FORECASTING FOR THE RIVER RHINE AT RHEINFELDEN: EXPERIENCES AND PRESENT PROBLEMS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Geographisches Inst.
For primary bibliographic entry see Field 2E.
W88-01968

PREDICTION OF NITROGEN AND PHOSPHORUS LOSSES AS RELATED TO AGRICULTURAL DRAINAGE SYSTEM DESIGN,
North Carolina State Univ. at Raleigh. School of Agriculture and Life Sciences.
For primary bibliographic entry see Field 2G.
W88-02071

CATCHMENT ECOSYSTEMS AND VILLAGE TANK CASCADES IN THE DRY ZONE OF SRI LANKA: A TIME-TESTED SYSTEM OF LAND AND WATER RESOURCE MANAGEMENT,
Sri Lanka Univ., Peradeniya. Dept. of Geography.
For primary bibliographic entry see Field 3F.
W88-02237

CONTROL AND MANAGEMENT OF LAND USE AND WATER RESOURCES OF BHAVANI RIVER BASIN IN TAMIL NADU, INDIA,
Tamil Nadu Agricultural Univ., Coimbatore (India). Water Technology Centre.
For primary bibliographic entry see Field 3F.
W88-02238

UPSTREAM - DOWNSTREAM INTERACTIONS AS NATURAL CONSTRAINTS TO BASIN-WIDE PLANNING FOR CHINA'S RIVER HUANG,

For primary bibliographic entry see Field 4D.
W88-02240

SOME STRATEGIC PRINCIPLES FOR LONG-TERM RIVER BASIN DEVELOPMENT - THE CASE OF HAN RIVER,
Yangtze Valley Planning Office, Wuhan (China).
F. Ziyun.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 141-150, 3 fig.

Descriptors: *River basin development, *Water resources development, *Management planning, *Han River, *China, Long-term planning, Economic aspects, Environmental policy, River basins, Land use.

When formulating a river basin strategy economic benefits, social benefits and environmental benefits have to be considered in combination. The selected plan for the development of a river basin should pay reasonable attention to the benefits both for the parts concerned and for the whole area, both for the present time and for future, and to the consistency of productivity of nature and human being. Basic strategic principles for long term river basin development as illustrated from the Han River would include mitigation of disasters and damages, evaluation of water and land resources capabilities, assessment of the environmental impacts of actions, protection and multiple use of aquatic environments, control and protection of land resources, and preparedness for future changes. Thus, the river basin strategy must be formed in combining water resources planning, land use planning and environmental planning of the basin into an integral whole. (See also W88-02227) (Author's abstract)
W88-02241

PROBLEMS RELATED TO GROWING URBAN SYSTEMS FROM A RIVER BASIN PERSPECTIVE,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
G. Lindh.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 337-346, 5 fig, 28 ref.

Descriptors: *River system, *Urban areas, *River basin development, Water resources development, Social aspects, Economic aspects, Political aspects.

Because of the rapid growing of many urban areas it becomes more and more important to analyze the interactions caused by these areas with other parts of the river basin. In order to carry out such a study, the author tries to apply a systems approach where interactions between the rural and the urban areas are considered. The analysis is complicated by the fact that not only water related factors have to be taken into consideration, but also factors that indirectly exert influence on the development of the river basin. Human goals and aspirations as well as socio-political decisions may come to play an important role if we want a harmonic and sound development of urban ecosystems in conjunction with natural ecosystems. The paper mainly focuses on water flow processes between the different subsystems. (See also W88-02227) (Author's abstract)
W88-02262

NONLINEAR PROGRAMMING METHODS IN RESERVOIR SYSTEM MANAGEMENT,
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 2H.
W88-02273

GABIONS USED IN STREAM GRADE-STABILIZATION STRUCTURES: A CASE HISTORY,
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4D.
W88-02356

STOCHASTIC DYNAMIC PROGRAMMING BASED APPROACH TO THE OPERATION OF A MULTI-RESERVOIR SYSTEM,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-02376

ENHANCEMENT OF RIPARIAN ECOSYSTEMS WITH CHANNEL STRUCTURES,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
L. F. DeBano, and B. H. Heede.
Water Resources Bulletin WARBAQ, Vol. 23, No. 3, p 463-470, June 1987. 2 fig, 25 ref.

Descriptors: *Channel structures, *Riparian zones, *Streamflow, *Ecological effects, *Ecosystem management, *Sediment control, *Hydrodynamics, *Sedimentation, *Ecosystems, Planning, Dams.

Naturally occurring and man-made structures can be used for enhancing the development of riparian zones. Naturally occurring structures are cienagas, beaver dams, and log steps. Man-made structures include large and small channel structures and bank protection devices. All these structures affect streamflow hydraulics and sedimentation and can create a more favorable environment for riparian zone establishment. However, when they are used improperly, they can be destructive to existing riparian zones. Since stream processes are generally slow, long-time spans may pass before the effects of management action, good or bad, become visible. Also, the effects of large dam installations may appear a long distance downstream from the dam. Therefore, investigations must be of a wide scope. Interactions between riparian site, channel, and streamflow may be so complex that an interdisciplinary approach is required. (Author's abstract)
W88-02385

DESIGN OF DUAL-PURPOSE DETENTION SYSTEMS USING DYNAMIC PROGRAMMING,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
L. E. Ormsbee, M. H. Houck, and J. W. Delleur.
Journal of Water Resources Planning and Management JWRMD5, Vol. 113, No. 4, p 471-484, July 1987. 6 fig, 4 tab, 25 ref. OWRT Project OWRT-14-34-1110-0498.

Descriptors: *Storm water, *Detention reservoirs, *Flood control, *Design standards, *Water pollution control, *Urban runoff, *Algorithms, *Computer programs, Storage, Runoff, Pollution load.

Stormwater detention basins are increasingly being used to control both urban flooding and nonpoint urban pollution. In order to design such systems effectively some type of design algorithm is needed. Two different dynamic programming formulations are examined for use in the development of a general design algorithm for dual purpose detention systems. Both formulations can be used to determine the locations and required storage for each detention basin as well as the required dimensions of the basin and the associated outlet works. Importantly, the proposed formulations allow the inclusion of pollutant loads and associated constraints into the overall stormwater management problem. (Author's abstract)
W88-02413

4B. Groundwater Management

MINE WATER.
International Mine Water Association.
Proceedings of the Second International Congress. Volume 2, September 1985. 510 p. Edited by R. Fernandez-Rubio.

Descriptors: *Groundwater management, *Mine drainage, *Coal mining, *Water control, *Groundwater movement, *Aquifers, *Mining engineering, Grouting, Materials engineering, Groundwater, Geohydrology, Drainage, Case studies, Wells, Mathematical models, Model studies, Dewatering, Depressurizing, Groundwater level, Water level, Symposium, Conferences, Spain, Hazards, Safety.

The proceedings of an international symposium on mine water held in 1985 in Spain includes reports of work on the origins of mine water, surface mine dewatering techniques, underground mine dewatering techniques, the role of water in mine excavations, mine hazards related to water, and new engineering techniques for special cases. Mathematical models applied to the prediction of mine water inflows are also detailed. (See also W88-01408) (See W88-01555 thru W88-01592) (Lantz-PTT)
W88-01554

SURFACE PROTECTION PROBLEM IN CONDITIONS OF WATER HAZARD IN DIAPIR SALT MINES,
Glowny Inst. Gornictwa, Katowice (Poland).
G. Kortas, J. Wilk, and Z. Jasinski.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 709-722, 12 fig, 12 ref.

Descriptors: *Groundwater management, *Salt mines, *Mine water, *Poland, Groundwater movement, Geohydrology, Flow profiles.

The basic problem in underground mining of diapir salt deposits in Polish conditions, is the water surrounding salt domes. The water hazard in salt mines is indirectly connected with danger to the surface and environment of mining areas in case of water inrush. The drastic proof of that was the biggest catastrophe in the history of Polish mining - the flooding of one of the diapir salt mines in 1977. This paper presents symptoms of water hazard gradually growing in the years 1972-1977, describes the water inrush into the workings, deals with the effects of drainage of mining area and the mining damages caused by water flow under the built-up area. The processes restoring hydrogeological equilibrium and the settlement of surface displacements in the period from 1978-1985 are described. It is necessary to protect the surface under conditions of water hazard in salt mines. (See also W88-01554) (Lantz-PTT)
W88-01564

GROUNDWATER FLOW SUBMODEL FOR THE ANALYSIS OF REGIONAL WATER POLICIES IN OPEN-PIT LIGNITE MINING AREAS,
Technische Univ., Dresden (German D.R.). Inst. of Lignite Mining.
D. Peukert, B. A. Gutt, B. Rossbach, and S. Kaden.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 765-775, 5 fig, 7 ref.

Descriptors: *Groundwater management, *Groundwater movement, *Lignite mines, *Water policy, *East Germany, Model studies, Flow profiles, Simulation analysis, Water management.

An approach to groundwater flow submodels for the analysis of regional water policies in a test region in the German Democratic Republic located in the Lusatian Lignite District is outlined. An introductory methodological overview on the use of comprehensive groundwater flow simulation models in lignite mining is given. For the test region the interactions between mine dewatering, remaining pit utilization, surface/groundwater flow, etc. have been investigated with the help of one such groundwater flow model, described in brief here. Based on these investigations, submodels have been developed analyzing the interrelationships between the state of the groundwater system and selected decisions on mine dewatering and water resources management. The methodological approach is described and illustrated with practical example. (See also W88-01554) (Author's abstract)
W88-01569

HYDROGEOLOGIC ASPECTS OF THE ABANDONMENT OF AN UNDERGROUND LEAD-ZINC MINE,

Idaho Univ., Moscow. Coll. of Mines and Earth Resources.
D. R. Ralston, and R. E. Williams.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 777-788, 9 fig.

Descriptors: *Geohydrology, *Lead, *Zinc, *Mine wastes, *Groundwater management, *Water quality control, *Acid mine drainage, Water pollution control, Groundwater movement, Path of pollutants, Flow profiles, Pollutant load.

Acid mine drainage related to pyrite oxidation is a serious environmental and economic concern. Research on minimizing poor quality drainage after abandonment of an acid producing mine is taking place at the Bunker Hill Mine, located in northern Idaho. The Bunker Hill is a large underground lead-zinc mine nearing the end of its operating life. It discharges acid water by a combination of gravity drainage and pumpage amounting to about 95 L/sec. The pH is 2.8 and zinc concentration averages 120 mg/L. The objective of this research is to describe the water flow systems and water quality distributions in the mine quantitatively in order to evaluate the benefits of alternative reclamation plans to minimize acid water discharge after abandonment. Graphs of flow and zinc loading at six sites demonstrate the flow/quality characteristics of the mine. The temporal variations of flow and zinc concentrations vary with depth in the mine. There are seasonal variations in flow and zinc loading in the shallow workings. The mechanisms controlling flow and zinc concentrations have major implications regarding abandonment alternatives for the Bunker Hill Mine. The deeper portions of the mine can be flooded; this will decrease both the amount of water discharged and the zinc loading from the mine. However, the main acid producing areas in the upper workings cannot be flooded because of the large number of portals and the fractured nature of the rock mass. (See also W88-01554) (Author's abstract)
W88-01570

EFFECT OF GROUNDWATER RE-ESTABLISHMENT ON THE SETTLEMENT OF OPENCAST MINE BACKFILLS IN THE UNITED KINGDOM,

Nottingham Univ. (England). Dept. of Mining Engineering.
R. N. Singh, B. Denby, and S. M. Reed.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 803-816, 8 fig, 2 tab, 10 ref.

Descriptors: *Groundwater management, *Groundwater movement, *United Kingdom, Water table, Mines, Water flow, Groundwater budget, Backfill, Geohydrology.

Surface environmental problems associated with the reestablishment of the groundwater table on the settlement of opencast mine backfills in the United Kingdom are outlined. The factors affecting the rate of groundwater reestablishment are reviewed together with its effect on the settlement of opencast mine backfills. The research program includes investigations on two sites to monitor and evaluate recovery and settlement patterns in the mine backfills. From observations, the following conclusions can be made: (1) Settlement of opencast mine backfill is entirely due to the effect of groundwater recovery - except in the case of one instrument which has shown that the degree of previous compaction is of significant importance; (2) The rate of recovery in a mine backfill can be extremely rapid, (about 170-175 days), from the termination of pumping; (3) Once the fill has been saturated then settlement effectively ceases (Although a slower rate of settlement in the form of creep movements is thought to continue); and (4) Once a horizon is saturated then heaving movements are initiated. The maximum heave movements so far registered however are only in the region of 1-2 cm. (See also W88-01554) (Lantz-PTT)
W88-01571

REBUILDING OF ORIGINAL WATER BALANCE IN KARSTIC RESERVOIRS,

Central Inst. for Mining Development, Budapest (Hungary).
G. Szilagyi.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 841-847, 3 fig, 5 ref.

Descriptors: *Groundwater budget, *Groundwater management, *Karst hydrology, *Hungary, Precipitation, Groundwater recharge, Water balance, Groundwater movement, Grouting, Mine drainage, Drinking water, Groundwater supply.

Distortion has occurred in the Karst water balance of the Transdanubian Mountains, Hungary, because of a precipitation shortage, and a great volume of artificial water discharge. Rebuilding of the original water balance requires new, effective measures, including reducing mine water pumping by grouting; reinjection of mine water; utilization of mine water as drinking water in water supply systems and direct protection of thermal springs. (See also W88-01554) (Author's abstract)
W88-01574

SUBMODELS OF GROUNDWATER-SURFACE WATER INTERACTION FOR THE ANALYSIS OF REGIONAL WATER POLICIES IN OPEN-PIT LIGNITE MINING AREAS,

Institut fuer Wasserwirtschaft, Berlin (German D.R.).
For primary bibliographic entry see Field 2A.
W88-01575

MAIN DEWATERING OF MINES NEW COST SAVING TECHNIQUES,

Flygt A.B., Solna (Sweden).
B. Anden.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 891-895, 2 fig.

Descriptors: *Water pollution control, *Dewatering, *Groundwater management, *Economic aspects, *Mine drainage, Pumps, Cost analysis, Sedimentation.

The most common conventional method used today for the removal of mine waters is first to separate solids particles from the water in large sedimentation basins before pumping the clarified water out. Multistage clean water pumps are used for this operation. In addition to the high costs for the construction of the basins and pump foundations, operational costs are also high. The basins must be regularly emptied of settled sludge and the drainage pumps frequently repaired or replaced due to excessive wear by abrasive particles remaining in the water. With a new submersible pump, one can avoid investing in sedimentation basins. A simple water collection sump is all that is required. The new pump can be sunk at almost any suitable angle. The water, including the sludge and particles, will be pumped out directly. The pump is 2.7 m long, weighs 2.5 tons and contains two main sections: the motor and the pump. The simple installation and the low investment and maintenance costs, make this pump an interesting alternative for the main dewatering in newly opened mines and on new levels in existing mines. The test results and calculations of the total annual costs for this new pumping concept can offer more than a 30% savings compared to conventional techniques. (See also W88-01554) (Lantz-PTT)
W88-01578

WATER PROBLEM IN RELATION TO MINING AT MAGNESITE DEPOSITS IN SLOVAKIA,

Geologicky Prieskum, Spisska Nova Ves (Czechoslovakia).
D. Cabala.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 919-930, 13 fig, 1 tab, 2 ref.

Descriptors: *Groundwater movement, *Magnesite, *Mine drainage, *Czechoslovakia, Groundwater movement, Karstic hydrology.

The Slovak magnesite deposits in the Slovak Ore Mountains (Slovenske rudohorie) are situated in a belt reaching to the Lucenec Basin in the west and to the Kosice Basin in the east. The deposits are in two main West Carpathian tectonic units. This belt contains all West Carpathian magnesite deposits of high economic importance under exploitation at the present time. The present problems of mine water control in magnesite deposits under strong karstic water hazard are characterized by relatively water inrushes which may cause partial or total inundation, temporary break-down and endangerment of human life. Some characteristics and defined cases of actively exploited deposits are also reported. (See also W88-01554) (Lantz-PTT)
W88-01580

MINE DEWATERING DESIGN IN SURFACE MINING TO IMPROVE THE QUALITY OF GROUND WATER,

Universidad Politecnica de Madrid (Spain). Escuela Tecnica Superior de Ingenieros de Minas.
R. Fernandez-Rubio, J. L. Sastre, J. Casas, S. Fernandez-Lorca, and J. Fernandez-Lorca.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 931-941, 9 fig, 2 ref.

Descriptors: *Dewatering, *Groundwater management, *Mine drainage, Aquifers, Groundwater supply, Groundwater budget, Water use, Conflicting use, Irrigation, Municipal water.

The extraction of groundwater and the mining of mineral deposits may both: (a) disturb the hydraulic balance of the existing aquifers and (b) cause deep changes in their hydraulic conditions. Furthermore, where the inter-bedded sediments contain highly soluble evaporite rocks, the induced leakage due to water extraction may provoke large changes in the quality of groundwater. Studies and planning of an open-pit mine dewatering operation are described. The design was aimed to minimize the effect of the leakage between an unconfined heterogeneous aquitard-aquifer system and a semi-confined unconsolidated sands aquifer, in order to reduce the contamination of the groundwater used for the town water supply and for irrigation. (See also W88-01554) (Lantz-PTT)
W88-01581

GEOPHYSICAL PROSPECTING FOR MINED AREAS IDENTIFICATION. 'SAN JOSE' MINE CASE HISTORY (CACERES - SPAIN),

Compania General de Sondeos S.A., Madrid (Spain).
A. Granda, J. Casas, and J. L. Sastre.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 943-951, 6 fig, 6 ref.

Descriptors: *Geophysics, *Groundwater management, *San Jose Mine, *Spain, Resistivity, Groundwater, Geohydrology.

Geophysical methods, especially those of resistivity, offer interesting possibilities for use in the study of some problems which are related to subsurface water and mine diggings. Particularly attractive, due to its versatility, ease of use, and good results, the 'mise-a-la-masse' method is perhaps the one which has the greatest potential use in this field. A trial was carried out in the surroundings of the 'San Jose' Mine (Caceres-Spain). This is a mine which has been abandoned for years. The investigators sought to check the effectiveness of the method to define the position of the old drifts and the approximate magnitude of the exploitation. This study indicates that the distribution and position of the assumed areas mined is consistent with the geological model, and with previous information available. However, with a view to better solving the connection between drifts, and to extending the area under study, to define how far mining really took place, what forms of action are possible, which are now being considered and which will be carried out in the coming months. (See also W88-01554) (Lantz-PTT)
W88-01582

LIQUIDATION OF ABANDONED MINE EXCAVATIONS BY FLOODING,
Ceskoslovenska Akademie Ved, Prague. Ustav Geologie a Geotechniky.
J. Hanzlik, and J. Vydra.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 953-965, 6 fig, 2 tab, 2 ref.

Descriptors: *Mines, *Flooding, *Groundwater management, *Czechoslovakia, Excavations, Economic aspects, Mine drainage.

One method of abandonment of unproductive mine excavations consists of flooding an abandoned mine excavation in the upper parts of a mine, above its active part. The method has been practically tested at the Vitkov mine, in Western Bohemia. On the basis of the positive evaluation of structural, geohydrological and mining conditions of the mining space, and using appropriate safety measures, flooding of the old mining section was permitted. The flooding took place from November 1979 to August 1984. The project was finished after evaluation of the flooding, and proof of its stability. The use of this method contributed to substantial economic savings in mine operation, and improvement of land ecology. (See also W88-01554) (Lantz-PTT)
W88-01583

HOT WATER SEEPAGE INTO SHALLOW COAL MINES OF MANUGURU COALBELT, GODAVARI VALLEY COALFIELD ANDHRA PRADESH, INDIA,
Singareni Collieries Co. Ltd., Kothagudem (India).
For primary bibliographic entry see Field 2F.
W88-01585

HYDROGEOLOGICAL INVESTIGATIONS IN MINING (WITH REFERENCE TO USSR EXPERIENCE),
Leningrad Mining Inst. (USSR).
V. A. Mironenko.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 991-1001, 7 fig.

Descriptors: *Geohydrology, *Mine drainage, *Groundwater management, *Groundwater movement, Russia, Ecological effects.

The fundamental principles pursued by Soviet mining hydrogeologists are illustrated with examples from mining practice in the USSR. Topics discussed are: (1) the effect of water on the conditions of mining operations; (2) methods to manage this effect (drainage); (3) consideration for ecological aspects of mining and drainage; and (4) input information and principles of geohydrological exploration of deposits. (See also W88-01554) (Author's abstract)
W88-01586

STUDY OF FORMATION OF FISSURE-KARST WATER INFLOWS INTO MINE WORKINGS,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 2F.
W88-01590

WATER IN MINING AND UNDERGROUND WORKS (EL AGUA EN LA MINERIA Y TRABAJOS SUBTERRANEOS).
Associacion Nacional de Ingenieros de Minas, Granada (Spain).
Volume 3. (1984). 162 p. Edited by R. Fernandez-Rubio.

Descriptors: *Groundwater management, *Mine drainage, *Coal mining, *Water control, *Groundwater movement, *Aquifers, *Mining engineering, Grouting, Materials engineering, Groundwater, Geohydrology, Drainage, Case studies, Wells, Mathematical models, Model studies, Dewatering, Depressurizing, Groundwater level, Water level, Symposium, Conferences, Spain, Hazards, Safety.

The proceedings of an international symposium on mine water held in 1985 in Spain includes reports of work on the origins of mine water, surface mine dewatering techniques, underground mine dewatering techniques, the role of water in mine excavations, mine hazards related to water, and new engineering techniques for special cases. Mathematical models applied to the prediction of mine water inflows are also detailed. This final volume presents reports on: hydrogeological investigations applied to mining and underground work; mining works underwater and special techniques; the role of waters in mining works; mathematical models applied to drainage systems; contamination by mining wastes; and miscellaneous subjects. (See also W88-01408 and W88-01554) (Lantz-PTT)
W88-01601

GROUND WATER QUALITY PROTECTION,
Oklahoma Univ., Norman. Environmental and Ground Water Inst.
For primary bibliographic entry see Field 5G.
W88-01655

PREDICTING THE OCCURRENCE OF RADON-222 IN NORTH CAROLINA GROUNDWATER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W88-01760

SPATIAL DISTRIBUTION AND ANALYSIS OF GROUNDWATER NITRATE CONTAMINATION IN KALAMAZOO COUNTY, MICHIGAN,
Michigan State Univ., East Lansing. Center for Remote Sensing.
For primary bibliographic entry see Field 5B.
W88-01763

REGIONAL ECONOMIC GROWTH FROM IRRIGATION DEVELOPMENT: EVIDENCE FROM NORTHERN HIGH-PLAINS OGALLALA GROUNDWATER RESOURCE,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Natural Resource Economics.
For primary bibliographic entry see Field 6D.
W88-01911

WATER QUALITY ASPECTS OF ARTIFICIAL AQUIFER RECHARGE WITH TREATED WASTEWATER,
University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Programme.
For primary bibliographic entry see Field 5G.
W88-02092

CONTROL AND MANAGEMENT OF LAND USE AND WATER RESOURCES OF BHAVANI RIVER BASIN IN TAMIL NADU, INDIA,
Tamil Nadu Agricultural Univ., Coimbatore (India). Water Technology Centre.
For primary bibliographic entry see Field 3F.
W88-02238

OPTIMAL MANAGEMENT OF A REGIONAL AQUIFER IN EASTERN SAUDI ARABIA,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Earth Sciences.
H. Yazicigil, R. I. Al-Layla, and R. L. de Jong.
Water Resources Bulletin WARBAQ, Vol. 23, No. 3, p 423-434, June 1987. 9 fig, 3 tab, 18 ref. King Abdulaziz City for Science and Technology Grant AR-5-112.

Descriptors: *Optimization, *Aquifer management, *Water management, *Groundwater, *Model studies, *Saudi Arabia, Simulation, Planning, Aquifers, Drawdown, Policy making.

The formulation and application of a groundwater hydraulic management model to determine the optimal development and operating policies of a regional aquifer in the Eastern Province of Saudi Arabia is described. The hydraulic response of the aquifer system is represented by a simulation model that is linked to an optimization management model using response functions. Yearly optimal groundwater extraction rates over a planning horizon of 15 years are determined for four scenarios, each reflecting alternative groundwater development policies. The results are presented in the form of tradeoff curves, relating drawdowns to optimal pumpage, which may enhance the decisionmaker's ability to select the best development policy from a set of alternatives. The results illustrate how various optimal management schemes can be devised to increase the total withdrawal from the aquifer while preventing excessive dewatering. (Author's abstract)
W88-02381

4C. Effects On Water Of Man's Non-Water Activities

MINE WATER.
International Mine Water Association.
For primary bibliographic entry see Field 4B.
W88-01554

ASSESSING IMPACT OF SURFACE MINING ON RECHARGE,
New Mexico Bureau of Mines and Mineral Resources, Socorro.
W. J. Stone.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 829-840, 4 fig, 4 tab, 13 ref.

Descriptors: *Surface mining, *Recharge, *Tracers, *Groundwater recharge, Hydrologic budget, Chlorides, Recharge rates, Groundwater budget.

Recharge is an important consideration in assessing hydrologic impact of surface mining, because it is a major component of the water budget of the area. However, recharge data are often not available and measurement by the usual chemical and physical methods is complex, time-consuming, and expensive. An alternative chemical method, based on the chloride content of water in the unsaturated zone, is simple and relatively inexpensive. Application of this method to areas of active and proposed coal surface mining in the southwestern United States has made it possible to compare premining and present recharge rates so that the impact of post-mining reclamation on recharge may be assessed. Plots of cumulative chloride content vs. cumulative water content provided a means of estimating late Pleistocene and Holocene recharge rates. These higher rates may be considered worst-case values inasmuch as the Quaternary climate was wetter than the present climate. Recharge estimates based on the chloride method have generally been corroborated by those of other chemical and physical methods where this has been attempted. The chloride method should prove useful in assessing impact of most surface mining operations on recharge. (See also W88-01554) (Author's abstract)
W88-01573

GROUND-WATER REACTIONS TO SURFACE COAL MINING IN SEMIARID LANDS,
Montana Bureau of Mines and Geology, Butte.
W. A. Van Voast.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 861-873, 7 fig, 7 ref.

Descriptors: *Groundwater management, *Water quality, *Coal mines, *Semiarid regions, *Mine drainage, *Water pollution effects, Montana, Groundwater quality, Piezometry, Water analysis, Leaching, Groundwater pollution.

Coal beds that will be mined in southeastern Montana are aquifers that provide essential local water supplies. Mine cuts along aquifer outcrops create almost imperceptible piezometric changes. Mine cuts between outcrops induce rapid storage deple-

tion and associated piezometric depressions. One such cut near Decker induced 1250 cu m/day of flow from storage and has created a piezometric depression of 5 m or more as far as 4000 m from the mine. Effluents from active mines are chemically similar to other area waters because they are mixtures of groundwaters entering the mine cuts. Occasional high concentrations of nitrate do occur, however, as residuals from explosives. Spoils commonly contain mine-floor aquifers of wasted coal and coarse rubble at their bases, confined beneath finer-grained sand, silt, and clay. Hydraulic conductivities are comparable with those of undisturbed confined aquifers. Water quality in mined lands is highly diverse because of diverse spoils lithologies and poorly established groundwater circulation. Groundwater in spoils is more mineralized than in the coal beds; post-mining dissolved solids concentrations are 2- to 3-fold increases over pre-mining concentrations. Before-mining predictions of post-mining groundwater quality are very rough, at the present time relying upon saturated-paste analyses to determine available volumes and species of soluble salts. Efforts to improve the predictions by using column leach tests have not been very successful. Geochemical equilibrium between spoils and groundwater apparently does not become established in the early years after mining. (See also W88-01554) (Author's abstract)
W88-01576

LAND SUBSIDENCE EFFECTED BY DEWATERING OF OPEN-PITS,
POLTEGOR, Wroclaw (Poland).
J. Wojciechowski, and K. Serewko.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 875-889, 7 fig, 3 tab, 8 ref.

Descriptors: *Land subsidence, *Dewatering, *Mine drainage, *Poland, Groundwater budget, Hydrologic models, Model studies, Mathematical models, Mathematical studies.

In 1975, the construction of one of the world's biggest lignite open-pits, the Betchatow pit, was begun in central Poland. Opening out required the prior drainage of the overburden. At present the cone of drawdown extends for about 10 km and the maximum drawdown of the groundwater level in the pit is about 200 m. At the same time as dewatering began, a survey of the influence of drainage over the neighboring area was started. More than 3000 ground movement points were surveyed. Up to now, a maximal subsidence of 0.5 m has been recorded. Two theoretical interpretative models of the subsidence process were applied. The first model was based on Terzaghi's uniaxial consolidation theory. In the second one, it was assumed that the true process deviates from Terzaghi's principles due to the rock mass anisotropy. The survey results permitted the verification of both models. An approximation procedure was applied to determine the corrective coefficients expressing errors of the model parameters and processes not contained in the models. This model, together with corrective coefficients, permits detailed forecasts of land subsidence around open pit and dewatering operations. (See also W88-01554) (Author's abstract)
W88-01577

INFLUENCE OF MINING ON THE GROUNDWATER MINERALIZATION IN THE UPPER SILESIAN COAL BASIN,
Instytut Geologiczny, Sosnowiec (Poland). Upper Silesian Branch.
A. Rozkowski.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 1015-1025, 6 fig, 4 ref.

Descriptors: *Groundwater quality, *Mineralization, *Coal mining, *Environmental effects, *Poland, *Mine drainage, Groundwater movement, Flow profiles, Geohydrology.

The Upper Silesian Coal Basin covers an area of about 7500 sq km, within the Variscitic intermontane depression. It has been mined since the second half of the 18th century. The average depth of mining is about 650 m. An increase of mine water mineralization has been observed with depth from 0.2 to 372.6 g/cu dm. Isotope investigations have given an indication about the differentiated origin of waters, and their location in the flow system. Mine pumping about 1 million cu m/day has a great influence on the geohydrologic conditions in the coal basin. The artificial hydraulic interconnections created by mine activity and deep drainage, have caused changes in the natural regime of groundwater movement. In these circumstances, atmospheric waters penetrate to a considerable depth into Carboniferous deposits and frequently become mixed with relict brines. Taking into account these phenomena, mine water mineralization is lower than observed before mining. The refreshing effect due to mining activity depends mainly on the depth of mining, drainage activity and geological conditions of the area. (See also W88-01554) (Author's abstract)
W88-01588

TOWARDS A WATER BALANCE IN THE CENTRAL AMAZONIAN REGION,
Universidade Estadual Paulista, Botucatu (Brazil). Faculdade de Ciencias Agronomicas.
P. R. Leopoldo, W. Franken, E. Salati, and M. N. Ribeiro.
Experientia EXPEAM, Vol. 43, No. 3, p 222-233, March 15, 1987. 9 fig, 7 tab, 54 ref.

Descriptors: *Environmental effects, *Amazon River basins, *Tropical regions, Deforestation, *Water balance, Forestry, Soil quality, Erosion, Soil temperature.

Until the 1960s the Amazonia forest cover remained essentially intact. However, with the construction of roads in the 70s colonization, accompanied by deforestation, set in with ever-increasing speed. Under the auspices of the 'Instituto Nacional de Colonizacao e Reforma Agraria', the government alone removes an average of 25,000 sq km of forest/yr. As a result of this process, national and international concern has intensified. Some authors claim that the energy liberated by the condensation of water vapors from the Amazon Basin, which is transported in the higher atmospheric strata to the polar regions, represents an important contribution to the thermal equilibrium of the earth. Others hypothesize that even complete deforestation would have little global impact. Fortunately, though, matters have moved beyond mere conjecture and dispute. National and international agencies have cooperated in setting up a number of research programs on the interaction between vegetation and atmosphere throughout the northern Brazilian states and through the Amazon Basin as a whole, including the neighboring countries. However, in view of the enormous problems, that would arise from a possible destabilization of the Amazonian ecosystem, these efforts must be considered as a modest beginning and as an incentive for continued research. Some possible effects of deforestation include: (1) poor soil quality due to full exposure to solar radiation; (2) elevation of soil temperature; (3) disruption of soil fauna; (4) reduced infiltration rates; and (5) an increase in soil erosion. (Lantz-PTT)
W88-01887

CHANGING ILLINOIS RIVER,
Illinois Univ. at Urbana-Champaign. Water Resources Center.
For primary bibliographic entry see Field 5C.
W88-02244

GROUNDWATER QUALITY PROTECTION POLICIES FOR THE ROCKY MOUNTAIN REGION AND THE NATION.
Colorado Water Resources Research Inst., Fort Collins.
For primary bibliographic entry see Field 5G.
W88-02269

INTRODUCTION TO ENVIRONMENTAL SCIENCE,
Wisconsin Univ.-Green Bay.
For primary bibliographic entry see Field 5A.
W88-02321

URBAN HYDROLOGY: A MULTIDISCIPLINARY PERSPECTIVE,
T. R. Lazaro.
Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 249 p.

Descriptors: *Urban hydrology, *Urban planning, *Urban watersheds, Hydrologic systems, Urbanization, Streamflow, Water quality, Hydrologic models, Urban runoff, Structural engineering.

Urban hydrology is one of the major problems facing cities today; it involves all aspects of the flow of stormwater through urban areas to receiving watercourses. Considerable portions of urban budgets are devoted to the safe conveyance of this water, either through sewerage systems or in channels. A related problem concerns the deterioration of the water's quality as it travels through urban areas, reduces the recreation potential of rivers, adds to the cost of water processing, and generates many environmental controversies. All this occurs within man's supervision, and even though the most sophisticated technology yet devised is available. The major failing concerns specialization and its spinoff, the lack of effective and earnest communication. Specialization has developed society into a very complex and viable functional unit, but at the same time it has built up formidable communication barriers. An example of this concerns many scientists who, after reviewing a study conducted in a field other than their own, overlook the benefits of full comprehension of this research. In this manner, much research is duplicated and consequently much time, effort and expense is wasted. Therefore, it is necessary to cultivate multidisciplinary communication. This book is intended to be a multidisciplinary vehicle; to present to scientists in different fields urban hydrology and its problems, and to suggest methods of solution. Topics presented are: (1) city physiology and anatomy; (2) impact of urbanization on streamflow; (3) urbanization and stream water quality; (4) analysis of hydrologic change due to urbanization; (5) modeling urban water quantity and quality; (6) nonstructural control measures; and (7) structural control measures. (Lantz-PTT)
W88-02326

NEW STUDIES OF URBAN FLOOD FREQUENCY IN THE SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
V. B. Sauer.
Transportation Research Record TRREDM, No. 1073, p 10-15, 1986. 3 tab, 12 ref.

Descriptors: *Urban areas, *Urban hydrology, *Urban runoff, *Flood frequency, *Flood peak, *Model studies, *Regression analysis, Estimating, Prediction, Equations, Floods.

Five reports dealing with flood magnitude and frequency in urban areas in the southeastern United States have been published during the past 2 years by the U.S. Geological Survey (USGS). These reports are based on data collected in Tampa and Tallahassee, Florida; Atlanta, Georgia; and several cities in Alabama and Tennessee. Each report contains regression equations useful for estimating flood peaks for selected recurrence intervals at ungauged urban sites in their respective study area. A nationwide study of urban flood characteristics by the USGS published in 1983 contains equations for estimating urban peak discharges for ungauged sites throughout the United States. At the time that the nationwide study was conducted, data from only 35 sites in the southeastern United States were available. The five new reports contain data for 88 additional sites in the southeastern United States. These new data show that the seven-parameter estimating equations developed in the nationwide study are unbiased and have prediction errors less than those described in the nationwide report. On the other hand, the new data indicate that the three-parameter equations are biased and significantly underestimate flood

discharge in four of the new study areas. The five new reports on the southeastern United States and the nationwide report provide reliable methods for estimating design discharges. (Author's abstract)
W88-02352

EMERGING STATE ROLES IN URBAN STORMWATER MANAGEMENT,
North Carolina Univ. at Chapel Hill. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 6E.
W88-02383

DIMENSIONLESS SOLUTION OF LAG TIME FOR DIVERGING SURFACE,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W88-02442

4D. Watershed Protection

IMPORTANCE OF SOIL CONSERVATION IN THE CONTEXT OF RIVER BASIN REALITIES,
Government of India, New Delhi. Advisory Board on Energy.
For primary bibliographic entry see Field 6A.
W88-02233

METHODS OF LAND AND WATER CONSERVATION IN THE WUDING RIVER BASIN,
Ministry of Water Resources and Electric Power, Beijing (China).
For primary bibliographic entry see Field 3B.
W88-02235

PROBLEMS OF LAND USE AND WATER RESOURCES MANAGEMENT IN THE UPPER TANA CATCHMENT IN KENYA,
Natural Resources Development Conservatory, Nairobi (Kenya).
G. S. Ongwenyi.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 123-130, 2 tab.

Descriptors: *Land use, *Water resources development, *Water management, *Upper Tana River, *Kenya, *Sedimentation, Catchment areas, Erosion, Monitoring, Sediment yield, Soil loss, Education.

The land and water development program within the upper Tana basin in E Kenya is based on a universal soil loss equation for the river basin, hillslope plot experiments and monitoring of sediment yields at the outlet of this subcatchment. Soil erosion and sedimentation were evaluated using data from sediment yield monitoring studies between 1948 and 1965, sediment production rates during the 1970's, and national assessments of soil losses and sedimentation rates. Problems for hydropower production, need for sediment measurement and evaluation, sources of sediment, and education and training, are also discussed. (See also W88-02227) (Lantz-PTT)
W88-02239

UPSTREAM - DOWNSTREAM INTERACTIONS AS NATURAL CONSTRAINTS TO BASIN-WIDE PLANNING FOR CHINA'S RIVER HUANG,
P. Mosely.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 131-140, 4 fig, 1 tab, 15 ref.

Descriptors: *Water resources development, *Water management, *China, *Huang River, Management planning, Silt, Flood control, River basins, Water conservation, Agriculture, Sedimentation.

The upstream-downstream interrelations among the river basin problems of the River Huang, China, are intricate. The basin in characterized by heavy silt production in the middle part - severely accelerated by far-reaching adherance to Mao's strategy 'Make grain the key link' - and flood control in the lower reaches, throughout history plagued by inundations and flood breaches. The steepness of the upper reaches make them the natural center for hydropower potential and industry. The present land use of the loess plateau and fertile plain drained by the middle reaches, is characterized by integrated soil and water conservation, withdrawal of agriculture from hilltops, and silt traps in the valley bottoms to produce new fertile land. The overriding consideration in the lower reaches is flood control and control of sedimentation to stop the river bed from rising. This creates contradictions with other land uses, as exemplified from the Beijin flood detention area, not in use for that purpose during the past 30 years. (See also W88-02227) (Author's abstract)
W88-02240

GABIONS USED IN STREAM GRADE-STABILIZATION STRUCTURES: A CASE HISTORY,
Iowa State Univ., Ames. Dept. of Civil Engineering.
G. J. Hanson, R. A. Lohnes, and F. W. Klaiber.
Transportation Research Record TRREDM, No. 1073, p 35-42, 1986. 8 fig, 2 tab, 6 ref.

Descriptors: *Gabions, *Grade stabilization, *Stream degradation, *Erosion control, *Bank stabilization, *Stream stabilization, *Erosion, Performance evaluation, Design criteria, Streams, Case studies, Entrenchment, Construction materials, Sediments, Costs.

Streams in western Iowa have been degrading since the turn of the century and this entrenchment has endangered many highway and railroad bridges. Although grade-stabilization structures have been effective in controlling this erosion, the cost of reinforced-concrete structures has risen to the point that less expensive materials need to be considered. In an effort to evaluate alternative materials for this purpose, a gabion drop structure was designed and built and its performance monitored for 2 years after completion. The demonstration structure has performed satisfactorily with minimal differential settling and minor erosional problems downstream of the structure. Sedimentation occurred upstream of the structure during construction but little additional sediment has accumulated since. A cost analysis that normalizes several variables is used to compare the gabion structure with concrete structures and indicates that the cost of building the gabion structure was about 20 percent of that of a comparable-size concrete structure. It is concluded that this type of structure is an effective and economic alternative. (Author's abstract)
W88-02356

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

SLUDGE CHARACTERISTICS,
Wilkins and Wheaton Engineering Co., Kalamazoo, MI.
G. E. Jones.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 83-90, 4 tab, 3 ref.

Descriptors: *Sludge, *Pollutant identification, *Wastewater sludge, Physical properties, Chemical properties, Metals, Sludge solids, Organic compounds, Microorganisms, Nutrients, Combustability.

A survey by the US EPA of publicly owned treatment facilities in the United States showed that approximately 40% of the facilities required upgrading because of their location on a water quality-limited segment of a river or stream. Additional sludge production by plants under expansion results in additional waste activated sludge and chemical sludge production. It is the sludge characteristics from any facility that must be thoroughly reviewed prior to the evaluation and selection of a suitable disposal alternative. Sludge testing and analysis have shown wide variations in the chemical and physical properties of the various sludges. The parameters generally measured in the analysis of sewage sludges depend on the options for final disposal. The characteristics generally include the following: physical characteristics; basic chemical composition; concentrations of metals; btu value of sludge; mineral nutrients of the dry sludge solids; and organic chemicals and pathogenic organisms. Additional characteristics to be considered are: sludge combustability and nutrient values. (See also W88-01499) (Lantz-PTT)
W88-01504

CONCEPTS, COSTS AND USES OF GAS CHROMATOGRAPHY AND GAS CHROMATOGRAPHY/MASS SPECTROSCOPY IN THE ANALYSIS OF SLUDGE,
Environmental Research Group, Inc., Ann Arbor, MI.
R. A. Copeland.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 99-102.

Descriptors: *Pollutant identification, *Gas chromatography, *Mass spectrometry, *Sludge, *Waste treatment, Costs.

The basic concepts of gas chromatography and gas chromatograpy/mass spectrometry (GS/MS) are briefly outlined and suggestions are given for waste treatment plant managers on how to keep to a minimum the organic analytical costs associated with their operating permits. These include: (1) defining the problem; and (2) negotiating the analytical permit parameters with the applicable regulatory agency. Although the suggestions are geared to the regulatory climate in Michigan, they should be applicable to any state. (See also W88-01499) (Lantz-PTT)
W88-01506

CASE HISTORY OF SAMPLING PROBLEMS IN A SLUDGE LAGOON,
Environmental Control Technology Corp., Ann Arbor, MI.
J. E. Schenk.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 103-106.

Descriptors: *Case studies, *Sludge, *Pollutant identification, Wastewater treatment, Sludge lagoons, Waste disposal, Polychlorinated biphenyls.

A case history of one investigation into the disposal of sludges collected over a number of years in storage lagoons serves to illustrate several details that may need to be considered in evaluating ultimate disposal options. Based on the analysis of the sludge, it was determined that approximately 50% of the PCB was present as mono-, di- or trichlorinated, 24% present as tetrachlorinated and 26% as higher chlorinated biphenyls. Only 65% of the total PCB would remain after one year, 41% after three years and 34% after five years. Assuming that no other problems exist with respect to the sludge, this would indicate that only one-third of the initially required area would be necessary to provide a safe level of PCB after a five-year period. (See also W88-01499) (Lantz-PTT)
W88-01507

TOXIC ELEMENT COMPOSITION OF ACID MINE WATERS FROM SULFIDE ORE DEPOSITS,
Geological Survey, Menlo Park, CA.
D. K. Nordstrom, and J. W. Ball.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 749-758, 10 fig, 1 tab, 12 ref.

Descriptors: *Pollutant identification, *Acid mine drainage, *Sulfides, *Path of pollutants, Fate of pollutants, California, Virginia, Colorado, Heavy metals, Sulfates, Zinc, Cadmium, Copper, Alumi-

num, Iron, Arsenic, Lead, Nickel, Cobalt, Chromium, Hydrogen ion concentration.

Acid mine waters from metal sulfide deposits located in non-carbonate (silicate) bedrock have been analyzed from four different localities in the United States: Iron Mountain mine, California; Leviathan mines, California; Argo tunnel, Colorado and Sulfur mine, Virginia. The range of pH is 0.5-3.0 and concentrations of Fe, Al, Zn, Cu, As, Cd, Pb, Tl, Ni, Co, Cr, V and SO4 are often extraordinarily high and certainly at toxic levels. Various plotting techniques, especially when combined with chemical equilibrium computations, are shown to be powerful tools for interpreting the source composition and downstream attenuation of metals during flow through a drainage basin. The results demonstrate that As and Tl are highly nonconservative and are rapidly removed from solution during downstream transport. However, Zn, Cd, Li and SO4 are highly conservative and are only marginally removed from solution. Aluminum shows both conservative and nonconservative behavior with a clear break in this behavior at a pH of about 4.5; i.e., at higher pH values a strong solubility control by microcrystalline gibbsite is demonstrated, whereas at pH values less than 4.5, a simple dilution line indicates mixing with no solubility control. (See also W88-01554) (Author's abstract)
W88-01567

DETERMINATION OF ORGANIC SUBSTANCES IN WATER,
T. R. Crompton.
John Wiley and Sons, Chichester, England. Volume 1, 1985. 560 p.

Descriptors: *Water analysis, *Pollutant identification, *Water pollution sources, *Organic compounds, Hydrocarbons, Aromatic compounds, Organochlorines, Insecticides, Tissue analysis, Herbicides, Polychlorinated biphenyls.

The body of information available throughout the world on the occurrence and determination of organics in all types of water and effluents is reviewed. Detailed procedures are given for many of the more important techniques, so that reference to a very scattered literature can in many cases be avoided. Chapter 1 covers hydrocarbons and polyaromatic hydrocarbons. Chapter 2 deals with the various types of surface active agents while Chapters 3 and 4 respectively discuss the numerous types of organochlorine and organophosphorus insecticides and herbicides and polychlorinated biphenyls now in use agriculture which are finding their way into the water courses. Particular groups of substances which are causing concern by their presence in the environment are discussed in detail, e.g. polyaromatic hydrocarbons, chlorine and phosphorus insecticides, herbicides, polychlorinated biphenyls, haloforms and organometallic compounds. In addition to discussing the analysis of river, surface and underground waters and potable water, various sections include discussion of ocean and beach waters, sewage and trade effluents and muds and sediments. In certain instances, the analysis of fish, crustaceae and plant life for organic pollutants is also discussed. Such measurements are very useful as these will reflect the general level of pollution that has occurred over a period of time, as opposed to spot measurements obtained by analysis of water samples. (See also W88-01600) (Lantz-PTT)
W88-01599

DETERMINATION OF ORGANIC SUBSTANCES IN WATER,
T. R. Crompton.
John Wiley and Sons, Chichester, England. Volume 2, 1985. 518 p.

Descriptors: *Pollutant identification, *Water pollution sources, *Organic compounds, Organometallic compounds, Carbon, Oxygen, Halogens, Nitrogen, Sulfur, Phosphorus, Ozonation, Pigments, Insecticides, Herbicides, Tissue analysis.

The body of information available throughout the world on the occurrence and determination of organics in all types of water and effluents is reviewed. A particular feature is the presentation of detailed procedures in the case of many of the more important techniques, so that reference to a very scattered literature can in many cases be avoided. This volume discussed: Chapter 1, organometallic compounds - organomercury, organoarsenic, organotin, organolead, organogermanium, and organoantimony; Chapter 2, oxygen compounds, such as fatty acids, glycols, aldehydes, esters, carbohydrates, lactams, phenols, etc.; Chapter 3, nitrogen, phosphorus, and sulfur compounds; and final chapters addressing ozonation products and natural pigments. As well as discussing the analysis of river, surface and underground waters and potable water, various sections include discussion, where relevant, of ocean and beach waters, sewage and trade effluents and muds and sediments. In certain instances, the analysis of fish, crustaceae and plant life for organic pollutants is also discussed. Such measurements are very useful as these will reflect the general level of pollution that has occurred over a period of time, as opposed to spot measurements obtained by analysis of water samples. (See also W88-01599) (Lantz-PTT)
W88-01600

PROFIENCY TESTING OF WATER MICROBIOLOGY LABORATORIES IN THE NETHERLANDS,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.
For primary bibliographic entry see Field 5G.
W88-01710

PRESENCE OF ERWINIA CAROTOVORA IN SURFACE WATER IN NORTH AMERICA,
Colorado State Univ., Fort Collins. Dept. of Plant Pathology and Weed Science.
For primary bibliographic entry see Field 2H.
W88-01711

HERBICIDE LEVELS IN RIVERS DRAINING TWO PRAIRIE AGRICULTURAL WATERSHEDS (1984),
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5B.
W88-01800

ENUMERATION OF FECAL COLIFORMS AND E. COLI IN MARINE AND ESTUARINE WATERS: AN ALTERNATIVE TO THE APHA-MPN APPROACH,
Public Health Service, Davisville, RI. Technical Services Unit.
S. R. Rippey, W. N. Adams, and W. D. Watkins.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 8, p 795-798, August 1987. 5 tab, 12 ref.

Descriptors: *Pollutant identification, *Filtration, *Coliforms, *Escherichia coli, *Membranes, Estimating, Estuaries, Water quality, Performance evaluation, Shellfish, Statistical analysis, Marine environment, Microbiological studies.

The mTEC and APHA-MPN procedures for fecal coliform and E. coli recovery from various marine and estuarine waters were compared in this study. Water samples were collected at numerous sites in Washington, Oregon, Connecticut, Virginia, Massachusetts, California, and Rhode Island. Intervals between collection and assay did not exceed six hours. Results of a paired t-statistic test showed no significant difference (95% confidence) in fecal coliform recovery between the two methods at 8 out of 9 sites. Relative percent recovery (mTEC/MPN) was 59-118% with a mean recovery of 92%. The advantages of using a membrane filtration approach rather than APHA-MPN are: results are obtained much more rapidly, less time is required to conduct an assay, the method is more precise than MPN, especially when plates with 20 to 80 target colonies are enumerated, and the cost per assay and the labor required are dramatically reduced. (Airone-PTT)
W88-01829

ANALYSIS OF SUB-MICROGRAM LEVELS OF PALLADIUM (II) IN ENVIRONMENTAL SAMPLES BY SELECTIVE EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION WITH N-P-METHOXYPHENYL-2-FURYLACRYLOHYDROXAMIC ACID AND 5-(DIETHYLAMINO)-2-(2-PYRIDYLAZO)PHENOL,
Centre for Water Resources Development and Management, Kunnamangalam (India). Water Quality and Environment Div.
S. A. Abbasi.
Analytical Letters ANALBP, Vol. 20, No. 7, p 1013-1027, 1987. 2 fig, 4 tab, 21 ref.

Descriptors: *Pollutant identification, *Palladium, *Spectrophotometry, *Chemical analysis, Hydroxamic acids, Extractions.

Nine new hydroxamic acids in conjunction with four pyridylazo reagents were explored for extractive separation and spectrophotometric determination of palladium in environmental samples. It was found that maximum sensitivity and selectivity was achieved by employing N-p-methoxyphenyl-e-furylacrylohydroxamic acid (MFHA) and 5-(diethylamino)-2-(2-pyridylazo)phenol (DEPAP). Palladium was first selectively extracted with MFHA in isoamyl alcohol at pH 2.7-3.5 and the extract was equilibrated with a mixture of 5 M HCl and 10 to the -3rd M solution of DEPAP in ethanol. The resulting intensely green ternary complex was measured at 560 nanometers (epsilon = 51,000 L/mole/cm). The extraction system is suitable for enrichment of palladium over 15 times without loss in recovery and enables determination of palladium at levels as low as 10 to the -4th ppm (0.1 ppb). The method tolerates the presence of a large number of diverse ions normally associated with palladium, including platinum metals, and was employed for the determination of palladium in standard catalysts, biological materials, and freshwaters. (Author's abstract)
W88-01832

SEPARATION STUDIES OF AS(III), SB(III) AND BI(III) BY REVERSED-PHASE PAPER CHROMATOGRAPHIC TECHNIQUE,
Institute of Science, Bombay (India). Dept. of Analytical Chemistry.
B. Raman, and V. M. Shinde.
Analytical Letters ANALBP, Vol. 20, No. 7, p 1029-1042, 1987. 4 fig, 4 tab, 12 ref.

Descriptors: *Pollutant identification, *Arsenic, *Chromatography, *Antimony, *Bismuth, Triphenylphosphine oxide, Chemical analysis, Chemical reactions.

Reversed-phase paper chromatographic separations of As(III), Sb(III) and Bi(III) have been carried out on Whatman No 1 filter paper impregnated with triphenylphosphine oxide as stationary phase and using organic complexing agents such as sodium acetate, sodium succinate and sodium malonate solutions as active mobile phases. Results for the separation of binary and ternary mixtures are reported and the method has been successfully applied to the separation and detection of these elements present in real samples and at ppm concentration level. A summary of the method indicates that: (1) The method is suitable for the separation of As(III), Sb(III) and Bi(III) both from binary and ternary mixtures at the ppm concentration level; (2) The sensitivity of the proposed method is high; (3) Separation and detection time is between 30-40 minutes for a 10 cm development; (4) Analysis of real samples such as a water sample, a ryeflour sample, white metal and solder is feasible by this method; and (5) The method has a high degree of precision. (Lantz-PTT)
W88-01833

COMPARISON OF SOLVENT EXTRACTIONS AND RESIN ADSORPTION FOR ISOLATION OF MUTAGENIC COMPOUNDS FROM CHLORINATED DRINKING WATER WITH HIGH HUMUS CONTENT,
National Public Health Inst., Kuopio (Finland). Dept. of Environmental Hygiene and Toxicology.
T. Vartiainen, A. Liimatainen, S. Jaaskelainen, and

P. Kauranen.
Water Research WATRAG, Vol. 21, No. 7, p 773-779, July 1987. 5 fig, 4 tab, 24 ref.

Descriptors: *Drinking water, *Water analysis, *Humic matter, *Resins, *Adsorption, *Solvent extraction, XAD resins, Mutagens, Organic compounds, Toxicity, Chemical analysis, Blue-Cotton, Chlorination.

Several methods of liquid-liquid extraction, and XAD resin and Blue-Cotton adsorption were compared for concentrating mutagenic organic compounds from humus-containing drinking water. Mutagenicity was measured by the Ames test, using strains TA 100 and TA 98 without metabolic activation. Continuous liquid-liquid extraction for 48 h and resin adsorption gave comparable and adequately reproducible results. 'Salting out' by sodium chloride improved the yield to some extent. Diethyl ether was more effective as extractant than dichloromethane. Two consecutive extractions in Ultra Turrax with salting out were needed to yield the same level of activity as continuous liquid-liquid extraction. Extraction by mechanical mixing as well as adsorption by Blue-Cotton gave inadequate yields. The highest yield for mutagenic compounds was obtained from acid (pH 1 or 2) solution by extraction as well as by resin adsorption. It is concluded that the main mutagens in humus-rich chlorinated drinking water are acidic polar compounds. (Author's abstract)
W88-01837

IDENTIFICATION AND DETERMINATION OF 4-(CHLOROMETHYLSULFONYL)BROMOBENZENE, A NEW HERBICIDE ADDITIVE, IN LAKE WATERS,
National Inst. for Environmental Studies, Tsukuba (Japan). Div. of Chemistry and Physics.
H. Shiraishi, and A. Otsuki.
Water Research WATRAG, Vol. 21, No. 7, p 843-847, July 1987. 6 fig, 2 tab, 9 ref.

Descriptors: *Pollutant identification, *Herbicides, *Lakes, *Lake Kasumigaura, *Japan, *4-(Chloromethylsulfonyl)bromobenzene, *Lake Biwa, Gas chromatography, Chemical analysis, Mass spectrometry, Agricultural runoff, Water pollution sources.

The structure of a compound found in water extracts from several Japanese lakes, which was highly sensitive to an electron capture detector (ECD), was identified as 4-(chloromethylsulfonyl)-bromobenzene by gas chromatography/mass spectrometry. Analysis of marketed herbicides revealed that this compound was contained in a certain herbicide as one of the additives, and the occurrence of this compound was due to the use of this herbicide in a paddy field. It was shown that the residue levels in Lake Kasumigaura were high in July after the application of the herbicide, and decreased gradually at all sampling stations. The fact that high residual levels were maintained in the center of the lake for long time in a year suggests that this compound may be persistent in aquatic environment. This compound was also found in Lake Biwa water, but the levels were much lower than in Lake Kasumigaura. (Author's abstract)
W88-01846

USE OF THE ALGAL GROWTH POTENTIAL TEST FOR DATA ASSESSMENT,
Environmental Protection Agency, Athens, GA. Environmental Services Div.
R. L. Raschke, and D. A. Schultz.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 4, p 222-227, April 1987. 4 fig, 2 tab, 27 ref.

Descriptors: *Algal growth potential, *Data assessment, *Pollutant identification, *Water quality control, Phosphorus, Pollution load, Nutrients, Mathematical models, Phytoplankton.

A compilation of 10 years of experience in the southeast U. S. using the standard algal growth potential test (AGPT) to diagnose and correct environmental situations within the jurisdiction of the U.S. EPA mandate. Data from more than 1200 tests is presented. Potential dry weight values range from 0.03 to 65.59 mg dry weight/L. The mean, mode, and median for this data set are 8.50, 0.22, and 2.86 mg dry weight/L, respectively. Generalizations or guidelines are presented for determining regulatory action levels, for better assessing phosphorus wasteload allocations, and accurately determining limiting nutrient status of waters. In particular, application of the AGPT in evaluating nutrient conditions, in providing data for mathematical models, and in evaluating phytoplankton dynamics is discussed. (Author's abstract)
W88-01855

CHEMICAL COMPOSITION OF FRESH SNOW ON MOUNT EVEREST,
Wyoming Univ., Laramie. Dept. of Geography and Recreation.
M. D. Jenkins, J. I. Drever, R. G. Reider, and T. Buchanan.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 9, p 10999-11002, September 20, 1987. 3 fig, 2 tab, 4 ref.

Descriptors: *Chemical analysis, *Snow, *Mount Everest, *Pollutant identification, *Acid rain, *Rocky Mountains, Sulfates, Nitrates, Calcium, Hydrogen ion concentration.

One hundred freshly fallen snow samples were collected from the north side of Mount Everest between 5,600 and 7,100 m elevation in April and May of 1986. Compared to snow from the Rocky Mountains of Wyoming, the Everest samples have lower sulfate and nitrate concentrations, reflecting a lesser anthropogenic input and much higher calcium concentrations and pH. The calcium concentrations and high pH presumably reflect a large but variable input of calcium carbonate dust either from arid areas to the west and north or from more local glacial deposits. (Author's abstract)
W88-01860

DETERMINATION OF PARTS-PER-BILLION CONCENTRATIONS OF DIOXANE IN WATER AND SOIL BY PURGE AND TRAP GAS CHROMATOGRAPHY/MASS SPECTROMETRY OR CHARCOAL TUBE ENRICHMENT GAS CHROMATOGRAPHY,
Clayton Environmental Consultants, Inc., Novi, MI.
P. S. Epstein, T. Mauer, M. Wagner, S. Chase, and B. Giles.
Analytical Chemistry ANCHAM, Vol. 59, No. 15, p 1987-1990, August 1, 1987. 1 fig, 5 tab, 9 ref.

Descriptors: *Pollutant identification, *Dioxane, *Gas chromatography, *Mass spectrometry, Soil contamination, Chemical analysis, Water analysis, Charcoal, Flame ionization, 2-butane, 4-methl-2-pentanone, Butoxyethanol.

Two methods for the determination of 1,4-dioxane in water have been studied. The first method is a heated purge and trap gas chromatography/mass spectrometry system following salting out with sodium sulfate. The second method is an adsorption on coconut-shell charcoal and solvent desorption with carbon disulfide/methanol followed by analysis of the desorbate by gas chromatography with flame ionization detection. The first method is also successful for the determination of 1,4-dioxane in solids and sediment. The second method is successful for 2-butanone, 4-methyl-2-pentanone, and butoxyethanol in water. The two methods are compared by analyzing 15 samples by both methods. The results of the two methods were similar. (Author's abstract)
W88-01868

FLUORIMETRIC DETERMINATION OF NITRATE IN NATURAL WATERS WITH 3-AMINO-1,5-NAPHTHALENEDISULPHONIC ACID IN A FLOW-INJECTION SYSTEM,
Okayama Univ. (Japan). Dept. of Chemistry.
S. Motomizu, H. Mikasa, and K. Toei.
Analytica Chimica Acta ACACAM, Vol. 193, p 343-347, February 14, 1987. 4 fig, 2 tab, 8 ref.

Descriptors: *Pollutant identification, *Fluorimetry, *Nitrates, *Water analysis, Salts, 3-Amino-1,5-Naphthalenedisulphonic acid, Flow injection analysis, Azoic acid.

A rapid, sensitive and precise flow injection method for the determination of nitrate in natural waters is presented. Nitrate is first reduced in a copperized cadmium column to nitrate, which reacts with 3-amino-1,5-naphthalenedisulphonic acid to form the azoic acid. This acid forms a fluorescent salt in alkaline medium. The relative standard deviation for 10 injections of 0.00002 M nitrate was 0.8%, and the detection limit (S/N = 3) is 1.0 times 10 to the -8th power M nitrate. (Author's abstract)
W88-01870

ESTIMATES OF ACIDIFICATION OF LAKES IN THE MT. ZIRKEL WILDERNESS AREA, COLORADO,
Geological Survey, Lakewood, CO.
J. T. Turk, and D. H. Campbell.
Water Resources Research WRERAQ, Vol. 23, No. 9, p 1757-1761, September 1987. 4 fig, 1 tab, 22 ref. USEPA Agreement DW-149303327-01-0.

Descriptors: *Acid rain, *Pollutant identification, *Water pollution sources, *Lake acidification, *Acidic water, *Lakes, Water pollution, Data interpretation, Colorado, Mt. Zirkel Wilderness Area, Alkalinity, Anions, Sensitivity analysis, Mathematical models, Model studies, Estimating.

Seventy lakes in the Mt. Zirkel Wilderness Area, Colorado, were sampled for alkalinity, and 20 of these lakes were sampled for major anions. Analysis of the data indicates that most of the lakes are extremely sensitive to acidification; about half of the lakes have alkalinities less than 100 microeq/liter. A linear regression of alkalinity against lake altitude accounts for 55% of the variance in alkalinity among the lakes, whereas a regression of alkalinity against dominant geologic unit (exclusive of altitude) accounts for 63% of the alkalinity variance. A conceptual model of lake acidification allows estimation of the quantity of acidification that may have occurred. Acidity associated with strong acid anions probably neutralized no more than 9 microeq/liter of alkalinity. This estimate is much smaller than a previous estimate for nearby Colorado lakes. (Author's abstract)
W88-01915

BEHAVIOUR OF ALKYLPHENOL POLYETHOXYLATE SURFACTANTS AND OF NITRILOTRIACETATE IN SEWAGE TREATMENT,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
W. Giger, M. Ahel, M. Koch, H. U. Laubscher, and C. Schaffner.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 449-460, 1987. 9 fig, 5 tab, 8 ref.

Descriptors: *Surfactants, *Pollutant identification, *Wastewater treatment, *Nonionic surfactants, *Municipal wastewater, Activated sludge process, Alkylphenol polyethoxylates, Organic compounds, Sludge, Effluents, Switzerland, Activated sludge, Nitrilotriacetate.

Effluents and sludges from several municipal sewage treatment plants in Switzerland were analyzed for nonylphenol polyethoxylates (NPnEO, n=3-20), nonylphenol mono- and diethoxylate (NP1EO, NP2EO), corresponding nonyl phenoxy carboxylic acids (NP1EC, NP2EC), and nonylphenol (NP). These chemicals derive from nonionic surfactants of the NPnEO-type, and specific analytical techniques were used to study their behavior during mechanical-biological sewage and subsequent sludge treatment. The parent NPnEO-surfactants, with concentrations in raw and mechanically treated sewage from 400-2200 mg/cu m, were relatively efficiently removed by the activated sludge treatment. The abundance of the different metabolites varied depending on treatment conditions. The refractory nature of NP1/2EO, NP, and NP1/2EC was recognized. Both biotrans-

formations and physico-chemical processes determine the behavior and fate of nonylphenolic substances in sewage treatment. Nitriloacetate (NTA) was found in primary effluents at concentrations between 430 and 1390 mg/cu m. The various treatment plants showed different removal efficiencies for NTA depending on the operating conditions. Activated sludge treatment with low sludge loading rates and nitrifying conditions removed NTA with efficiencies between 95 and 99%. High sludge loading caused a decrease in NTA removal efficiencies from 70% to 39%. (Author's abstract)
W88-01939

APPLICATION OF ENZYME ASSAYS FOR TOXICOLOGICAL WATER TESTING (ANWENDUNG ENZYMATISCHER VERFAHREN IN DER WASSER-TOXIKOLOGIE),
Stadtwerke Mainz A.G. (Germany, F.R.).
U. Obst, A. Holzapfel-Pschorn, and M. Wiegand-Rosinus.
Zeitschrift fur Wasser-und Abwasser-Forschung ZWABAQ, Vol. 20, No. 5, p 151-155, October 1987. 6 fig, 2 tab, 7 ref.

Descriptors: *Enzyme assays, *Hazardous materials, *Water analysis, *Pollutant identification, *Toxicity, *Chemical analysis, Water quality, Biochemical tests, Enzymes, Microbiological studies.

Two different criteria for biochemical toxicity testing are proposed: the effect of hazardous substances on the metabolic activity of the natural microflora and the determination of such substances by a standardized enzyme testing system. To measure effects on the microbial metabolic activity there are various simple in vivo enzyme assays using chromogenic or of fluorogenic substrates. To detect unknown substances with harmful effects there exist some in vitro enzyme tests with commercial preparations of defined purity and sensitivity. The performance, sensitivity, and some data on the practical use of such tests are presented. (Author's abstract)
W88-01972

REPORT ABOUT EXPERIENCES IN INTERCOMPARISON STUDIES IN THE ADMINISTRATION FOR WATER ECONOMY OF RHEINLAND-PFALZ (ERFAHRUNGSBERICHT UBER RINGVERSUCHE IN DER WASSERWIRTSCHAFTSVERWALTUNG VON RHEINLAND-PFALZ),
Wasserwirschafts amt Kaiserlautern (Germany, F.R.).
H. Blandfort, R. Buttstedt, H. J. Hemmrich, H. Jung, and D. Rinne.
Zeitschrift fur Wasser-und Abwasser-Forschung ZWABAQ, Vol. 20, No. 5, p 168-173, October 1987. 2 fig, 6 tab, 14 ref.

Descriptors: *Water quality, *Chemical analysis, *Water management, *Water analysis, Chemical oxygen demand, Biological oxygen demand, Ammonia, Nitrogen, Sulfates, Nutrients.

A short report is given for some intercomparison studies of COD, BOD5, NH4(+), -N, Cl(-) and SO4(2-) in laboratories of the Administration for Water Economy of Rheinland-Pfalz. The results which were obtained from studies in the years from 1980 to 1985 are satisfactory, but they give rise to some critical considerations of the analytical procedure for COD determination and in the use of the resulting values in administration of the German Federal Water Acts. (Author's abstract)
W88-01975

COMPARISON OF STATIONARY HPLC-PHASES FOR THE SEPARATION AND DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS (16 PAH'S OFF NBS-STANDARD) (VERGLEICH STATIONARER HPLC-PHASEN FUR DIE TRENNUNG UND BESTIMMUNG POLYCYCLISCHER AROMATISCHER KOHLENWASSERSTOFFE (16 PAH'S UMFASSENDER STANDARD NACH NBS)),
Gesamthochschule Paderborn (Germany, F.R.). Fachbereich 13 - Chemie und Chemietechnik.
H. Kicinski, and A. Kettrup.
Zeitschrift fur Wasser-und Abwasser-Forschung ZWABAQ, Vol. 20, No. 5, p 174-179, October 1987. 9 fig, 4 tab, 6 ref.

Descriptors: *Pollutant identification, *Chemical analysis, *Aromatic compounds, *Hydrocarbons, Organic compounds, Fluorescence.

Stationary phases of several column distributors were studied and compared for the separation and determination of the 16 polycyclic compounds included in the EPA Priority Pollutant List using an HPLC-gradient program. In addition to the UV-detection, the more selective and sensitive fluorescence method that uses programmable wavelength fluorescence detection was tested. (Author's abstract)
W88-01976

HEADSPACE TECHNIQUE TO DETERMINE THE PRESENCE OF VOLATILE HALOCARBONS IN DRINKING WATER. THE PROBLEMATIC ARISING FROM THE PREPARATION OF A BLANK SAMPLE AS WELL AS THE CLEANSING OF THE SAMPLING APPARATUSES (HEADSPACE-TECHNIK ZUR BESTIMMUNG VON FLUCHTINGEN CHLORKOHLENWASSERSTOFFEN IN TRINKWASSER. PROBLEMATIK DER ERSTELLUNG VON NULLWASSER SOWIE REINIGUNG DER PROBENAHMEGEFASSE),
Gemeinnutzige G.m.b.H., Algau (Germany, F.R.).
H. J. Briegel, and W. Brunn.
Zeitschrift fur Wasser-und Abwasser-Forschung ZWABAQ, Vol. 20, No. 5, p 180-182, October 1987. 2 fig, 5 ref.

Descriptors: *Volatile organics, *Pollutant identification, *Drinking water, *Halogenated organic compounds, *Quality control, Organic compounds, Water quality, Chemical analysis, Halogens, Laboratory equipment.

The necessity for special cleansing of test tubes as well as blank samples used to determine the presence of volatile halocarbons is demonstrated. In almost every laboratory it is inevitable that traces of these substances are present in the air, which could falsify a quantitative determination of halocarbons. By using hydrogen peroxide, it is possible not only to clean the test tubes of possible halocarbon impurities but also to prepare a blank solution which is virtually free of volatile halocarbons. The proposed cleansing procedures are simple and can be carried out in a short time. (Author's abstract)
W88-01977

PREPARATION OF ENVIRONMENTAL SAMPLES FOR THE DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS BY THIN-LAYER CHROMATOGRAPHY,
Wayne State Univ., Detroit, MI. Dept. of Chemistry.
S. K. Poole, T. A. Dean, and C. F. Poole.
Journal of Chromatography JOCRAM, Vol. 400, p 3233-341, July 2, 1987. 7 fig, 4 tab, 62 ref. EPA Contract No. R-81303801-0.

Descriptors: *Aromatic compounds, *Hydrocarbons, *Pollutant identification, *Chemical analysis, *Thin-layer chromatography, Chemical analysis, Organic compounds, Anthracene, Fluoranthene, Benz(a)anthracene, Perylene, Pyrene, Coronene.

An evaluation of extraction procedures, liquid-liquid distribution systems, Sen-Pak cartridges, liquid-solid chromatography using silica, alumina and chemically modified silica packings (acid-base treated ethyleammonium nitrate and picric acid impregnated), macroreticular resins and gel permeation columns for the analysis of polycyclic aromatic hydrocarbons (CPAHs) in environmental samples by thin-layer chromatography is discussed. For particulate samples solvent extraction using a Soxhlet apparatus or ultrasonication was found to be preferable to sublimation and liquid-liquid distribution between hexane and dimethyl sulfoxide followed by silica gel column chromatography was the preferred method for sample cleanup. Using this procedure enabled six PAHs (anthracene, fluoranthene, benz(a)anthracene, perylene, pyrene, and coronene) to be determined quantitatively in urban air particulate, diesel engine exhaust particulate, laboratory ventilator dust, household dust, river water, and tea samples. The PAHs were identified by coincidence of retention between the sample and standards in the same chromatographic system and by adequate agreement with standards for their normalized emission response ratios. The two-point calibration method was used for quantitation. Good agreement for the concentration of PAHs in the air particulate and diesel particulate extracts with published data using gas chromatography-mass spectrometry and high-performance liquid chromatography was found. (Author's abstract)
W88-01983

DETERMINATION OF TRACE LEVELS OF PHENOL AND CRESOLS IN RAIN BY CONTINUOUS LIQUID-LIQUID EXTRACTION AND HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. Czuczwa, C. Leuenberger, J. Tremp, W. Giger, and M. Ahel.
Journal of Chromatography JOCRAM, Vol. 403, p 233-241, August 21, 1987. 2 fig, 3 tab, 23 ref.

Descriptors: *Pollutant identification, *Phenols, *Cresols, *Rain, *Liquid chromatography, *Water analysis, Chemical analysis, Trace levels, Fluorescence, Water analysis.

Trace levels of phenol and methylphenols (cresols) in aqueous samples were determined by continuous liquid-liquid extraction and normal-phase high-performance liquid chromatography with UV-fluorescence detection. The recovery of phenol from water at a concentration of 1.6 micrograms/L was 70 + or - 6%. The method successfully measured traces of phenol and cresols extracted from rainwater without further cleanup. The average reproducibility of the method for rain samples was + or - 16%. The results compared well with those obtained by high-resolution gas chromatography-mass spectrometry. (Author's abstract)
W88-01984

DESIGN AND PERFORMANCE OF A NEW MEDIUM FOR THE QUANTITATIVE RECOVERY OF STAPHYLOCOCCUS AUREUS FROM RECREATIONAL WATERS,
Malaga Univ. (Spain). Dept. of Microbiology.
J. J. Borrego, J. A. Florido, P. R. Mrocek, and P. Romero.
Journal of Applied Bacteriology JABAA4, Vol. 63, No. 1, p 85-93, July 1987. 1 fig, 6 tab, 29 ref.

Descriptors: *Pollutant identification, *Water quality, *Staphylococcus aureus, *Recreation, Microbiological studies, Quantitative analysis.

Several reports have suggested that staphylococci, and especially Staphylococcus aureus, are useful indicators of pollution of recreational waters. The lack of selective, accurate and reliable recovery system for the quantification of Staph. aureus from water has been the principal obstacle to the evaluation of their use as indicators. In this study, several inhibitory substances and different nutrient sources have been evaluated for the formulation of a new selective medium. The medium designed, BFR-0 agar, recovers more than 75% of staphylococci and allows Staph. aureus to be identified. (Author's abstract)
W88-01985

DISTRIBUTION AND IN SITU SURVIVAL AND ACTIVITY OF KLEBSIELLA PNEUMONIAE AND ESCHERICHIA COLI IN A TROPICAL RAIN FOREST WATERSHED,
Puerto Rico Univ., Rio Piedras. Dept. of Biology.
A. J. Lopez-Torres, T. C. Hazen, and G. A. Toranzos.
Current Microbiology CUMIDD, Vol. 15, No. 4, p 213-218, 1987. 5 fig, 1 tab, 38 ref. Public Health

Service Grant Nos. RR-8102 and RR-2657, and Sea Grant R/LR-08-87-THA1.

Descriptors: *Tropical regions, *Rain forests, *Klebsiella pneumoniae, *Water pollution sources, *Escherichia coli, *Watersheds, *Pollutant identification, Coliforms, Puerto Rico, Water quality, Bacteria.

For a period of 7 months water samples were analyzed for the presence of Klebsiella pneumoniae and fecal coliforms at 11 sites in a cloud rain forest watershed in Puerto Rico. Diffusion chamber studies were conducted at two sites which were found to contain low numbers of naturally occurring K. pneumoniae and fecal coliforms. These studies indicated that both K. pneumoniae and Escherichia coli may be capable of surviving environmental conditions for extended periods of time. The presence of both bacteria in pristine natural waters is indicative of their being autochtonous to tropical environments. Thus the use of coliform and even fecal coliform bacteria as indicators of fecal pollution may be misleading when applied to countries with a tropical climate. (Author's abstract)
W88-01986

NEW, RAPID CLEAN-UP PROCEDURE FOR THE SIMULTANEOUS DETERMINATION OF DIFFERENT GROUPS OF ORGANIC MICROPOLLUTANTS IN SEDIMENTS; APPLICATION IN TWO EUROPEAN ESTUARINE SEDIMENT STUDIES,
Institute for Soil Fertility, Haren (Netherlands).
J. Japenga, W. J. Wagenaar, F. Smedes, and W. Salomons.
Environmental Technology Letters ETLEDB, Vol. 8, No. 1, p 9-20, January 1987. 4 fig, 9 ref.

Descriptors: *Pollutant identification, *Analytical methods, *Sample preparation, *Chromatography, *Estuaries, *Sediments, Sulfur, Organic compounds.

To determine organic micropollutants, estuarine sediment samples are pre-treated with acid, mixed with silica and Soxhlet-extracted with benzene/hexane. Humic substances and elemental sulfur are removed by passing the extract through a chromatographic column containing basic alumina on which sodium sulfite and sodium hydroxide were adsorbed. After silica fractionation the concentrations of PAH's, PCB's and chlorinated pesticides are determined gas chromatographically. Recovery experiments with added standards gave recoveries of between 90% and 102%. Samples from two different European estuaries were analyzed with this new desulfuration/fractionation procedure: Rotterdam harbor sediment (Netherlands) and river Elbe estuarine sediments (Western Germany). (Author's abstract)
W88-02007

MANUAL FOR DESIGN AND OPERATION OF A SOLENOID-BASED DELIVERY SYSTEM FOR AQUATIC TOXICITY TESTING,
Maryland Univ., Solomons. Chesapeake Biological Lab.
For primary bibliographic entry see Field 7B.
W88-02014

ISOLATION OF FUNGI FROM ENVIRONMENTAL SAMPLES,
W. B. Cooke.
Environmental Technology Letters ETLEDB, Vol. 8, No. 3, p 133-140, March 1987. 34 ref.

Descriptors: *Fungi, *Isolation, *Polluted identification, *Cultures, *Wastewater treatment, Wastewater, Effluents, Sludge, Nutrients, Oxygen.

The development of a suitable medium for the isolation and culture of fungi from sewage and sewage polluted water is described. Carbon/nitrogen ratios of culture media are noted. Water as a storage medium, oxygen requirements of fungi, and spore entrapment are discussed. Isolation of fungi from fresh water, polluted water, potable water, ambient water, and sludges is described and tabulated. (Author's abstract)
W88-02019

BIOMPHALARIA GLABRATA (SAY), A SUITABLE ORGANISM FOR A BIOTEST,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
A. Munzinger.
Environmental Technology Letters ETLEDB, Vol. 8, No. 3, p 141-148, March 1987. 3 fig, 1 tab, 8 ref.

Descriptors: *Bioassay, *Bioindicators, *Water pollution effects, *Biophalaria, Snails, Toxicity, Monitoring, Copper, Growth stages.

The embryonic development of a tropical freshwater snail (Biomphalaria glabrata, Say: Gastropoda, Pulmonata) is presented as a tool for monitoring pollutants in water. Laboratory rearing of the animal and four different embryonic stages, which are easily to recognize are described. The results of a study on the effect of Copper are reported. (Author's abstract)
W88-02020

MICROBIAL POLLUTION OF THE BLUE AND WHITE NILES AT KHARTOUM,
Khartoum Univ. (Sudan). Faculty of Agriculture.
D. M. Mahgoub, and H. A. Dirar.
Environment International, Vol. 12, No. 6, p 603-609, 1986. 5 fig, 2 tab, 11 ref.

Descriptors: *Pollutant identification, *White Nile, *Blue Nile, *Coliforms, Pollution load, Bacteria, Rivers, Microbiology.

The total coliform and fecal coliform bacterial load of the Blue and White Niles at Khartoum has been determined in the period of January-July 1984. The Blue Nile has been found to be more contaminated than the White Nile. The east bank of the White Nile was found to be more contaminated than the west bank. The microbial load of the rivers increased conspicuously as they passed through the city of Khartoum. (Author's abstract)
W88-02023

TRACING OF XENOBIOTIC CONTAMINATION IN WATER WITH THE AID OF FISH BILE METABOLITES: A FIELD STUDY WITH CAGED RAINBOW TROUT (SALMO GAIRDNERI),
Joensuu Univ. (Finland). Dept. of Biology.
A. Oikari, and T. Kunnamo-Ojala.
Aquatic Toxicology AQTODG, Vol. 9, No. 6, p 327-341, February 1987. 5 fig, 4 tab, 26 ref.

Descriptors: *Pulp wastes, *Beach plants, *Path of pollutants, *Fish bile, *Metabolism, *Field tests, *Trout, *Lakes, Industrial wastewater, Effluents, Enzymes.

Caging experiments were conducted using juvenile rainbow trout (Salmo gairdneri) in a lake area receiving chlorine-bleached kraft pulpmill effluents (BKME) from a single discharge pipe. The trout were exposed for 10 and 15 days at four locations downstream (1, 4, 6 and 11 km) and at one reference location upstream (2 km) from the effluent pipe. Water, blood and bile samples were collected and analyzed for concentrations of seven resin acids (RA) and eight chlorophenolic (CP) compounds. The activities of UDP-glucuronosyltransferase (UDP-GT) were measured in the livers of the experimental area formed a gradient system which was correlated with the concentrations of BKME in the water. The concentrations of free RA and CP in the blood plasma and bile of the caged trout were also distance related. This pattern was even more apparent in the total concentrations of conjugated RA and CP in the bile. The approximate bioconcentration factors in the trout plasma were 100 to 1,000 for RA and CP relative to the levels in the water. The hepatocellular concentration step, which involves conjugative biotransformations, further increased concentrations by a factor of 100 to 1,000. The overall gradient between the concentration of the parent compound in the water, ant its metabolites in bile, thus approximated 100,000 for RA and, in some cases, even approached 1,000,000 for CP. 15 days of exposure, the activity of UDP-GT in trout livers was significantly increased at distances between 4-11 km from the source of BKME. Establishment of the pattern of metabolically converted xenobiotics in the bile of caged rainbow trout is both a sensitive and (semi)quantitative way to assess low levels of contamination in recipient waters. (Author's abstract)
W88-02031

USE OF BIOASSAYS TO ASSESS AQUATIC ARTHROPOD MORTALITY FROM PERMETHRIN DRIFT DEPOSITS,
Forest Pest Management Inst., Sault Sainte Marie (Ontario).
For primary bibliographic entry see Field 5C.
W88-02037

BACTERIAL MUTAGENICITY AND CHEMICAL ANALYSIS OF POLYCYCLIC AROMATIC HYDROCARBONS AND SOME NITRO DERIVATIVES IN ENVIRONMENTAL SAMPLES COLLECTED IN WEST GERMANY,
York Univ. (England). Cancer Research Unit.
For primary bibliographic entry see Field 5C.
W88-02057

COLORIMETRIC DETERMINATION OF PHENOLS IN WATER SAMPLES,
Mansoura Univ. (Egypt). Faculty of Pharmacy.
S. M. Hassan, F. B. Salem, and N. A. El-Salam.
Analytical Letters ANALBP, Vol. 20, No. 5, p 677-687, May 1987. 4 fig, 3 tab, 6 ref.

Descriptors: *Pollutant identification, *Phenols, *Water sampling, *Colorimetry, Chemical analysis, Industrial wastewater, Organic compounds, Resorcinol, Drinking water.

The toxic nature of phenolic compounds has made it necessary to accurately detect very low concentrations of these compounds in natural water and industrial effluents. A number of colorimetric methods have been developed based on measurement of the intensity of colored derivatives; with 4-aminoantipyrine most widely used. Its disadvantages are that many ring compounds interfere in this reaction and p-substituted phenols do not react. Other published methods include periodic acid, p-aminodimethylaniline and 2,6-dibromoquinone chlorimide. In this article, a colorimetric method based upon the use of resorcinol as a reagent for the determination of phenols in drinking water has been developed. The proposed method is highly sensitive, simple, rapid and reactive with p-substituted phenols. Phenol reacts with nitrous acid to give nitrosophenol, which then couples with resorcinol. The reaction product has a maximum wavelength at 480 nanometers. The effects of different reagents were investigated to produce the optimum conditions of the reaction. Molar absorptivities, mean %-recovery values of authentic samples by the proposed, and 4-aminoantipyrine methods as well as the standard deviations using six trials are indicated. The concentration of phenol and alkyl derivatives calculated as phenol in raw water samples collected at random from different parts in Dakahlia Governorate are presented. Thin layer chromatography with a benzene/methanol solvent system was used. It has been found that samples contain p-cresol and this is the reason for the difference in concentration of phenol, since the reference method does not react with p-substituted phenols while the proposed method does. THis is the advantage of the proposed method over the 4-aminoantipyrine method. Furthermore, the minimum quantity detectable using the proposed method is 4 mcg/L as opposed to 10 mcg/L using the 4-aminoantipyrine method. (Lantz-PTT)
W88-02063

DETERMINATION OF RESIDUES OF FURADAN (CARBAFURAN) IN WATER BY SPECTROPHOTOMETRIC METHOD.
Roorkee Univ. (India). Dept. of Bioscience and Biotechnology.

Analytical Letters ANALBP, Vol. 20, No. 5, p 771-782, May 1987. 2 fig, 2 tab, 5 ref.

Descriptors: *Pollutant identification, *Furadan, *Carbafuran, *Spectrophotometry, Chemical analysis, Ceric sulphate, Water analysis, Insecticides, Water pollution.

A spectrophotometric method for the determination of carbafuran residues in field water using ceric sulphate as a reagent has been worked out. Furadan or carbafuran (2,2-dimethyl-2,3-dihydrobenzofuranyl-7 n-methyl carbamate) has attained wide use as a systemic soil insecticide. After carbafuran has been applied, residues may be present in aquatic systems via direct treatment of water or by runoff from treated areas into lakes, streams and ponds. The ceric sulphate method can be successfully employed for the determination of carbafuran, with results indicating that acceptable recoveries of (95 - 97%) carbafuran were obtained with the proposed procedure. The absorption spectrum of the colored compound was determined in the wavelength range from 350 to 600 nanometers, the absorption maximum occurring at 450 nanometers. (Lantz-PTT)
W88-02064

VIROLOGICAL STUDIES ON AN ANAEROBIC DIGESTION SYSTEM FOR LIQUID PIG MANURE,
Guelph Univ. (Ontario). Dept. of Veterinary Microbiology and Immunology.
For primary bibliographic entry see Field 5D.
W88-02076

SPECIFIC ANALYSIS OF OIL EMULSIONS IN WATER (DIFFERENZIERTE BESTIMMUNG VON OELEMULSIONEN IN WASSER),
Amt fuer Arbeitsschutz, Hamburg (Germany, F.R.).
R. Bohne-Matusall, K. Otto, and P. Wilderer.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 20, No. 2, p 35-38, April 1987. 2 tab, 9 ref.

Descriptors: *Analytical methods, *Measuring instruments, *Oil, *Emulsions, *Infrared spectroscopy, Hydrocarbons, *Chromatography, Detergents, Chemical analysis, Fatty acids, Bilge, Oily water, Municipal wastewater.

For the design and operation of treatment plants to separate emulsions from water, detailed knowledge of the chemical nature of the emulsions is required. A liquid chromatographic method was developed allowing rapid isolation and separation of anionic and nonionic detergents in the presence of hydrocarbons. The simultaneous analysis of hydrocarbons, fats and fatty acids is accomplished by infrared spectrometry at five different wavelengths. The proposed analytical technique allows saving of both time and costs for the analysis, compared to the common practice of analyzing single categories of compounds. The method was applied to an investigation of bilge water from ships, and one of municipal wastewater. (Author's abstract)
W88-02082

SEDIMENT QUALITY CRITERIA - GENERAL ASPECTS AND INTERNATIONAL STATE OF DISCUSSION (QUALITAETSKRITERIEN FUER GEWAESSERSEDIMENTE - ALLGEMEINE PROBLEMATIK UND INTERNATIONALER STAND DER DISKUSSION),
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
U. Foerstner, F. Ackermann, J. Alberti, W. Calmano, and F. H. Frimmel.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol 20, No. 2, p 54-59, April 1987. 26 ref.

Descriptors: *Analytical methods, *Path of pollutants, *Sedimentology, *Sediments, *Water quality standards, *Sediment-water interfaces, Interstitial water, Bioassay, Surface water, Water analysis, Suspended solids.

Sediment quality is coming more and more into the foreground in the evaluation of surface water quality, alongside the more intensively studied water phase. Limiting values for sediment quality, analogous to those in existence for years for surface water, are not available, partly due to gaps in understanding the complex interactions between sediment and the water phase, and the mechanisms of pollutant transfer from sediment to organisms. The panel 'Bodies of Water/Sediment' of the Water Chemistry Division of the German Chemical Society presents the current international state of the discussion of sediment quality criteria and invites technical suggestions. Five methodologies are described, based on research in the U. S. for environmental authorities (background or in-situ precontamination method, water quality/pore water comparison, sediment/water equilibria, sediment/organism equilibria, bioassays) as well as a sixth method (desorption or elution method). The methods include both pragmatic approaches emphasizing short-term practicability as well as those oriented rather to basic science. The latter contain a number of still-open questions and require much effort in application. The panel members agree that, as a goal, a scientifically grounded approach should be established, although this may mean that for an intermediate span of time, the need for easily available criteria may not be met. (Airone-PTT)
W88-02086

GERMAN TECHNICAL STANDARD FOR THE ASSESSMENT OF LAKE WATER QUALITY AND ITS APPLICATION TO HARTBEESPOORT DAM (SOUTH AFRICA),
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 2H.
W88-02091

239, 240PU LEVELS IN MUSSELS MYTILUS SP. COLLECTED FROM THE FRENCH COASTS (1983-1984): A RADIOCHEMICAL AND MICROANALYTICAL STUDY (SUIVI DES NIVEAUX DE PLUTONIUM 239-240 DANS DES MOULES MYTILUS SP. PREVELEES SUR LE LITTORAL FRANCAIS (1983-1984): ETUDES RADIOCHIMIQUE ET MICROANALYTIQUE),
CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses (France).
For primary bibliographic entry see Field 5B.
W88-02105

COMPARISON OF ACUTE TOXICITY EVALUATIONS AND EPA WATER QUALITY CRITERIA WITH MACROINVERTEBRATE COMMUNITY ANALYSIS AT SITES OF ELECTROFINISHING DISCHARGES TO STREAMS,
Massachusetts Dept. of Environmental Quality Engineering, Westborough. Div. of Water Pollution Control.
G. M. Szal.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 589-605, 1 fig, 9 tab, 25 ref, 2 append.

Descriptors: *Water quality control, *Toxicity, *Microbiological studies, *Metal-finishing wastes, *Macroinvertebrates, Chemical analysis, Water analysis, Water pollution effects, Environmental effects, Minnows, Daphnia, Microtox.

Two alternatives to toxicity tests commonly employed in effluent evaluations are chemical analysis and aquatic community studies. The first is a comparison of known toxic components of effluents to established criteria values. This method has the following shortcomings when compared with the live organism approach: (1) there is a lack of criteria for all but the most common toxicants; (2) synergistic and/or antagonistic interactions of components in a complex waste cannot be accounted for; (3) site specifics of receiving waters (e.g., hardness, pH) cannot be incorporated into most chemical evaluations; and (4) the chemical approach relies on the previous identification of toxic components of a waste. The second alternative, the instream community study, takes a completely different tack to effluent assessments than toxicity testing or chemical evaluations. While the toxicity testing is predictive and speculative with regard to impact, the instream community study establishes the severity of impact and describes its form. Results of acute tests and chemical analyses were used to calculate a predicted instream toxicity at each of four study sites. The following static acute tests were used: (1) the fathead minnow (Pimephales promelas) 48-hr test; (2) the Microtox 30-min test; and (3) the daphnia pulex or D. magna 48-hr tests. The Daphnia sp 48-hr static acute tests was the best predictor of impacts to macroinvertebrate communities of the three tests evaluated; they were also the most sensitive of the three tests to electrofinishing wastes evaluated. The Microtox test was nearly as sensitive as the Daphnia sp. tests and was a good predictor of impacts. The fathead minnow tests was the least sensitive of the three tests and was a poor predictor of impacts to macroinvertebrates. An application factor of at least 10 was necessary to successfully predict impacts using daphnid tests. A higher value would be required if the Microtox tests were used. EPA 30-day average criteria were good predictors of impacts to macroinvertebrate but should be used in conjunction with acute tests to evaluate electrofinishing wastes. (See also W88-02132) (Lantz-PTT)
W88-02192

SYSTEMATIC APPROACH TO THE DETECTION AND REMOVAL OF TOXIC ORGANIC POLLUTANTS IN DRINKING WATER,
State Univ. of New York at Albany. Dept. of Chemistry.
For primary bibliographic entry see Field 5F.
W88-02274

USING ASIATIC CLAMS AS A BIOMONITOR FOR CHRYSOTILE ASBESTOS IN PUBLIC WATER SUPPLIES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
S. E. Belanger, D. S. Cherry, J. Cairns, and M. J. McGuire.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 3, p 69-74, March 1987. 3 tab, 46 ref, 1 append. Dept. of the Interior Grants G1134151 and G11344151.

Descriptors: *Clams, *Bioindicators, *Monitoring, *Water quality management, *Water supply, *Asbestos, Indicators, Accumulation, Bioaccumulation, Biological magnification, Tissue analysis, Histology, Kidneys, Sampling, Microscopy, Electron microscopy.

Comparisons of Asiatic clams (Corbicula sp.) exposed to chrysotile asbestos in the laboratory and the field were undertaken in 1983 and 1984 to evaluate the usefulness of 30-day laboratory exposures for predicting the accumulation of chrysotile by clams in the field. Clams exposed in the laboratory accumulated fibers that were shorter and had greater aspect ratios (length to width) than those found in water. In the field, fibers in clam tissues were approximately the same size as those found environmentally. Bioconcentration factors (BCFs) for asbestos were low in the laboratory (slightly greater than 1). In the field, however, viscera BCFs were as high as 100, and whole clam homogenates ranged from 1,400 to 5,000. These data are consistent with the theory that asbestos fibers are difficult to depurate. It is concluded that Corbicula is a good candidate for use as a biomonitor for chrysotile asbestos contamination. (Author's abstract)
W88-02318

INTRODUCTION TO ENVIRONMENTAL SCIENCE,
Wisconsin Univ.-Green Bay.
J. M. Moran, M. D. Morgan, and J. H. Wiersma.
W. H. Freeman and Co., New York, NY. Second Edition, 1986. 709 p.

Descriptors: *Water pollution effects, *Environmental effects, *Pollutant identification, Ecosystems, Ecological effects, Population dynamics.

This book is both a basic science text and a text on environmental issues. This is reflected in the organization of the text's 20 chapters: The basic principles of ecology are introduced in Part I and then applied to a wide variety of environmental concerns in Parts II and III. Part I (Chapters 2-5) surveys the fundamental principles that govern the functioning of the environment. Part II (Chapters 6-15) explores dominant issues of environmental quality and management: water and air pollution; exploitation of the earth's rock, mineral, and fuel resources; waste disposal; endangered species; and conflicts in land use. Part III (Chapters 16-20) focuses on problems at the core of most environmental issues: growing human population and shortages in food and energy resources. (Lantz-PTT)
W88-02321

DETERMINATION OF THE BIODEGRADABLE FRACTION OF DISSOLVED ORGANIC MATTER IN WATERS,
Universite Libre de Bruxelles (Belgium). Groupe de Microbiologie des Milieux Aquatiques.
P. Servais, G. Billen, and M.-C. Hascoet.
Water Research WATRAG, Vol. 21, No. 4, p 445-450, April 1987. 6 fig, 1 tab, 2 ref. Syndicat des Communes de la Banlieue de Paris pour les Eaux Contract 30/83.

Descriptors: *Analytical methods, *Bioassay, *Organic carbon, *Sample preparation, *Water analysis, Bacteria, Biomass, Incubation, Growth.

Two bioassay procedures are proposed for determining biodegradable dissolved organic carbon (BDOC) in waters. Both involves sterile filtration of the sample, reinoculation with a natural assemblage of bacteria from the same origin as the sample, and incubation for at least 10 days in the dark at 20 C. In the first procedure, dissolved organic carbon (DOC) is followed, until a plateau is reached and the difference between initial and final DOC is taken as a measure of BDOC. In the second procedure, bacterial biomass and mortality rate are followed and the integrated flux of mortality during the incubation period is calculated and divided by the growth yield to give an estimate of BCOD. Both procedures provide closely concordant results. An example of application to the study of ozonation and biological activated carbon filtration in drinking water treatment is presented. (Author's abstract)
W88-02343

STUDY BY EPIFLUORESCENCE OF THE FATE OF THE TOTAL BACTERIAL FLORA IN A BOTTLED MINERAL WATER (ETUDE PAR EPIFLUORESCENCE DE L'EVOLUTION DE LA MICROFLORE TOTALE DANS UNE EAU MINERALE EMBOUTEILLEE),
Institut Pasteur de Lille, Villeneuve d'Ascq (France). Service des Eaux.
For primary bibliographic entry see Field 5B.
W88-02346

CRITERIA ESTABLISHING BIOFILM-KINETIC TYPES,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W88-02349

ELECTROTHERMAL ATOMIC-ABSORPTION SPECTROMETRIC ANALYSIS OF LAKE WATERS FOR MN, FE, PB, AND CD,
Department of Energy, New York. Environmental Measurements Lab.
S. J. Nagourney, M. Heit, and D. C. Bogen.
Talanta TLNTA2, Vol. 34, No. 5, p 465-472, May 1987. 2 fig, 11 tab, 25 ref.

Descriptors: *Analytical methods, *Measuring instruments, *Lakes, *Acid rain, *Limnology, *Acid deposition, *Heavy metals, *Spectrophotometry, Trace metals, Sample preparation, Interference, Manganese, Iron, Lead, Cadmium.

Analyses have been made for trace metals in surface waters from lakes known to be sensitive to inputs of acidic deposition. Electrothermal atomic-absorption spectrometry was used for direct measurement of the low metal concentrations. The studies revealed non-spectral interferences resulting from small amounts of inorganic material in the sample matrix that prevent accurate measurements of Mn and Pb. Several types of interferences were identified by means of a computer coupled to the atomic-absorption spectrometer and procedures to overcome them were evaluated. Matrix modification with nitric acid is required for the determination of Mn. Atomization from a platform inserted within the graphite tube is necessary for interference-free Pb determination. (Author's abstract)
W88-02359

LIQUID CHROMATOGRAPHIC DETERMINATION OF ALIPHATIC DIAMINES IN WATER VIA DERIVATIZATION WITH ACETYLACETONE,
Environmental Pollution Control Center, Osaka (Japan).
Y. Nishikawa.
Journal of Chromatography JOCRAM, Vol. 392, p 349-359, April 1987. 7 fig, 6 tab, 17 ref.

Descriptors: *Pollutant identification, *Analytical methods, *Chemical reactions, *Sample preparation, *Diamines, *Chromatography, Detection limits, Water analysis, Natural waters.

Traces of C2-C6 aliphatic diamines were derivatized with acetylacetone in an aqueous medium containing 1-4% dipotassium hydrogenphosphate, and the resulting derivatives were extracted with a Sep-Pak C18 cartridge and determined by reversed-phase high-performance liquid chromatography. The diamines could be determined in the range 1.23-14.32 ng/ml in water with relative standard deviation of 0.4-4.9%. The detection limits were 0.14-1.78 ng/ml for 100-ml water samples. The recovery of diamine derivatives from river-water and sea-water was 88-96% with relative standard deviation of 1.3-4.0% and 34-93% with relative standard deviations of 1.3-9.8%, respectively. (Author's abstract)
W88-02363

AUTOMATIC BOTTLE SEALING MECHANISM FOR SEQUENTIAL SAMPLING OF VOLATILE ORGANICS IN WATER,
Environmental Monitoring and Support Lab.-Cincinnati, OH.
J. Shou-Yien Ho.
Water Resources Bulletin WARBAQ, Vol. 23, No. 3, p 509-513, June 1987. 4 fig, 5 tab, 3 ref.

Descriptors: *Sampling devices, *Analytical methods, *Design criteria, *Volatile organic compounds, Simulation, Field tests, Volatilization, Water analysis.

The design, construction, and evaluation of two automatic bottle sealing mechanisms for the collection of volatile organic compounds in water are described. Manually collected samples were either stored in uncapped bottles or in bottles capped with the automatic bottle sealing mechanisms. After 24 hours' storage, significant losses of volatile compounds from uncapped samples occurred even if the samples were stored at 4 C, but not for the samples capped with the automatic bottle sealing mechanisms. The mechanism for sealing the sample bottles was integrated into a commercial sampler with minor modifications to the sampler. The sampling system was then evaluated under controlled conditions to simulate actual field sampling. The results showed that the system was suitable for taking sequential discrete water samples automatically for 24 hours without significant losses of volatile organic compounds. (Author's abstract)
W88-02390

EFFECT OF ADSORPTION ON CALIBRATION GRAPHS OBTAINED FOR LEAD, CADMIUM AND COPPER IN NATURAL WATER SAMPLES,
Al-Najah National Univ., Nablus (Jordan). Dept. of Chemistry.
R. Salim.
Journal of Environmental Science and Health (A) JESEDU, Vol. 22, No. 2, p 125-139, February 1987. 8 fig, 14 ref.

Descriptors: *Adsorption, *Analytical methods, *Calibration graphs, *Heavy metals, *Water analysis, *Natural waters, Lead, Cadmium, Copper, Ions, Metals.

Calibration graphs for lead, cadmium and copper have been obtained in natural water, in centrifuged natural water and in distilled water. These calibration graphs were repeated in each medium one time when acidified to pH 2.2 and another time when buffered to pH 7.4. The shape of the calibration graphs obtained in the various types of media has been explained with reference to adsorption of metal ions on the suspended particles of the natural water and on the container surfaces. An equation describing the adsorption process has been applied on the calibration graphs obtained for lead, cadmium and copper in natural water samples. The effect of time on the shape of calibration graphs has been also looked into. (Author's abstract)
W88-02399

CONCENTRATION OF TRACE METALS IN PRECIPITATION,
Atmospheric Environment Service, Downsview (Ontario).
L. A. Barrie, S. E. Lindberg, W. H. Chan, H. B. Ross, and R. Arimoto.
Atmospheric Environmental ATENBP, Vol. 21, No. 5, p 1133-1135, May 1987. 2 tab, 14 ref.

Descriptors: *Pollutant identification, *Rainfall, *Water chemistry, *Rural areas, *Heavy metals, Trace metals, Weather, Transport.

Recent precipitation chemistry data of known reliability indicate that typical rural concentrations of Cd, Cu, Pb, Ni, V and Zn are lower than those indicated by older measurements owing to sample contamination. Furthermore the concept of 'typical remote concentrations' may not be appropriate unless it is qualified by the distance from sources and the prevailing meteorological air masses. (Author's abstract)
W88-02407

INFLUENCE OF ALKALINE PARTICULATES ON THE CHEMISTRY OF FOG WATER AT DELHI, NORTH INDIA,
Indian Inst. of Tropical Meteorology, Poona.
L. T. Khemani, G. A. Momin, P. S. P. Rao, P. D. Safai, and P. Prakash.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 2, p 183-189, June 1987. 2 tab, 24 ref.

Descriptors: *Water chemistry, *Water analysis, *Fog water, *Alkalinity, *Air pollution, *Path of pollutants, *Acidity, Ions, India.

Chemical analysis of fog water collected by impaction in a pre-cooled chamber in Delhi has shown high concentrations of major ions. The dominant ions measured were Na(+), K(+), Ca(+2), and Mg(+2). The concentrations of acidic ions, SO4(-2) and NO3(-), were low. The pH values in the fog water were highly alkaline and varied from 6.4 to 7.6. The high concentrations of soil-oriented components, especially Ca(+2), were more than sufficient to neutralize the small acidity in the fog water and were responsible for maintaining high alkaline pH. The pH values of fog water did not attain the low values in India (Delhi), as found in other polluted environments of Europe and the northeast United States. (Author's abstract)
W88-02459

DETERMINATION OF ORGANIC ACID ANIONS IN PRECIPITATION BY ION CHROMATOGRAPHY EXCLUSION,
Illinois State Water Survey Div., Champaign. Analytical Chemistry Lab.
S. R. Bachman, and M. E. Peden.
Water, Air, and Soil Pollution WAPLAC, Vol. 33, No. 1/2, p 191-198, March 1987. 3 fig, 3 tab, 8 ref.

Group 5A—Identification Of Pollutants

DOE Contract DE-AC02-76EV01199.

Descriptors: *Analytical methods, *Organic acids, *Rainfall analysis, *Chromatography, *Acid rain, Anions, Rainfall, Sample preparation.

A method for the determination of organic acid anions in precipitation samples is described. The technique of ion chromatography exclusion (ICE) is used to identify and quantify the more commonly found anions of the acids citric, formic and acetic in central Illinois rainwater. By using a two column system consisting of a separator and suppressor, method detection limits (MDL) of 0.03 mg/L for each of the three anions are obtained. The total analysis time for quantitation is 24 min. Samples collected from early spring rains contained primarily formate and acetate ions with levels of concentration ranging from 0.03 to 0.44 mg/L. The organic acids formic and acetic contributed approximately 8% to the total acidity in the precipitation samples analyzed. Precision averaged 5% as the relative standard deviation (RSD) and analyte spikes of natural precipitation samples revealed a mean recovery of greater than 99%. A preservation technique using chloroform ($CHCl_3$) addition is discussed with results indicating its necessity in maintaining original organic anion concentrations. (Author's abstract)
W88-02469

INCIDENCE OF ANTIBIOTIC RESISTANT BACTERIA IN DRINKING WATER IN CAIRO,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
For primary bibliographic entry see Field 5B.
W88-02486

5B. Sources Of Pollution

SLUDGE AND ITS ULTIMATE DISPOSAL.
For primary bibliographic entry see Field 5E.
W88-01499

USE OF A BIOASSAY TO EVALUATE THE BIOACCUMULATION OF CONTAMINANTS BY ANIMALS COLONIZING A WETLAND CREATED WITH CONTAMINATED DREDGED MATERIAL,
Hoofdgroep Maatschappelijke Technologie TNO, Apeldoorn (Netherlands).
J. M. Marquenie, and J. W. Simmers.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 131-134, 1 tab. Contract No. DAJA-45-84-C-0015.

Descriptors: *Biossays, *Bioaccumulation, *Path of pollutants, *Wetlands, *Dredging, *Waste disposal, *New York, *Times Beach, Contaminated sediments, Ecological effects, Earthworms, Heavy metals, Polyaromatic compounds, Hydrocarbons, Polychlorinated biphenyls, Cadmium, Arsenic.

At Times Beach, Buffalo, N.Y., a prolific wildlife habitat has developed on a confined dredged material disposal facility. During 1983 studies were conducted to evaluate the availability of contaminants from the dredged material substrate to the animal community. The earthworm (Eisenia foetida) was used in growth chamber and field bioassay tests. After 28 days exposure the earthworms were harvested and analyzed for heavy metals, polyaromatic hydrocarbons (PAH's), and polychlorinated biphenyls (PCB's). Additionally, naturally occurring earthworms were collected from both the Times Beach site, and a reference site, and analyzed. The chemical analyses indicated significant accumulations of heavy metals, notably Cd and As; PCB's; and PAH's by the test and naturally occurring earthworms. The results of these studies are related to previously conducted plant bioassay and water quality studies at the site. (See also W88-01522) (Author's abstract)
W88-01536

PREDICTION AND FIELD EVALUATION OF THE WATER QUALITY OF EFFLUENT FROM CONFINED DISPOSAL AREAS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
M. R. Palermo.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 135-137, 1 fig.

Descriptors: *Water quality, *Dredging, *Path of pollutants, *Disposal sites, *Field tests, Waste disposal, Chemical analysis, Suspended solids.

A technique for predicting the quality of effluent from confined disposal areas during dredging operations has been developed as part of the Long-Term Effects of Dredging Operations (LEDO) Research Program. Such a technique is necessary for design and/or evaluation of disposal areas to ensure that applicable effluent standards can be met. The effluent quality predictions were directly compared with field data and the following conclusions were drawn: (1) the modified elutriate test adequately predicted the dissolved concentration of contaminants and the contaminant fractions of the total suspended solids in the effluent for the Field Verification Program (FVP) site. Comparison replicate test results with field data indicated that the modified elutriate test was a generally conservative predictor; (2) the column settling analysis and corresponding prediction of effluent suspended solids concentration compared favorably with field data and yielded a conservative estimate of the effluent suspended solids for the FVP site; (3) results from both the modified elutriate and column settling tests were used to predict total concentrations of contaminants in the effluent. These predictions were within a factor of 1.5 times the field values for total P, N, Cr, Cu, Mn, and PCB. Values for TOC, Fe, Pb, and Ni were 1.7 to 2.8 times the field value; and (5) the comparison of predicted and field data for the FVP site is an acceptable first generation test of the technique for prediction of the quality of effluent from confined disposal areas. (See also W88-01522) (Lantz-PTT)
W88-01537

MIGRATION AND CONTAINMENT OF LEACHANTS FROM URANIUM TAILINGS PONDS,
Carleton Univ., Ottawa (Ontario). Inst. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W88-01557

BEHAVIOUR OF RADIUM IN TAILINGS DAMS AND ENVIRONMENTAL WATERS IN THE WITWATERSRAND (SOUTH AFRICA) GOLD/URANIUM MINING AREA,
Nuclear Development Corp. of South Africa Pty Ltd., Pelindaba, Pretoria.
A. S. M. Jesus.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 633-645, 4 fig, 2 tab, 24 ref.

Descriptors: *Radium, *Radioactive wastes, *Uranium, *Gold, *Mine wastes, *Path of pollutants, *South Africa, Leaching, Soil contamination, Clays, Fate of pollutants, Pyrophyllite, Groundwater pollution.

Natural radioactivity present in tailings impoundments from the gold/uranium mines on the Witwatersrand is a potential source of contamination of environmental waters. The reason is the presence of large activities, although at low concentrations, of radium-226, a long-lived radioactive decay product of uranium not recovered during the extraction of gold and uranium, which can lead to potential health hazards. The situation on the Witwatersrand was assessed. Partition functions in tailings impoundments were determined in field and laboratory studies, from which very low values for the mobility of radium are deduced. Results are supported by the measured migration of radium into the soil underlying 30-40 yr old impoundments. Clay materials, in particular pyrophyllite in the impoundments, are identified as being one of the main substances responsible for the retention of radium. The distribution of radium in surface and groundwaters was investigated. It is concluded that the spread of radium in the Witwatersrand environment is insignificant. (See also W88-01554) (Author's abstract)
W88-01558

HEAVY METAL POLLUTION FROM MINING IN GREENLAND,
Groenlands Fiskeri- og Miljoeundersoegelser, Copenhagen (Denmark).
For primary bibliographic entry see Field 5C.
W88-01562

SYNERGETIC APPROACH TO CONTROL ACID MINE DRAINAGE: A MICHIGAN CASE HISTORY,
Michigan Technological Univ., Houghton. Inst. of Mineral Research.
For primary bibliographic entry see Field 5G.
W88-01563

MODELING OF MIGRATION PROCESSES WITH COUPLED MIGRANTS AND THEIR REDUCTION TO CONTROL MODELS,
Technische Univ., Dresden (German D.R.). Inst. of Lignite Mining.
For primary bibliographic entry see Field 5G.
W88-01566

TOXIC ELEMENT COMPOSITION OF ACID MINE WATERS FROM SULFIDE ORE DEPOSITS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5A.
W88-01567

BIOGENIC NATURE OF CORROSIVITY OF SULPHIDE DEPOSITS MINE WATER AND SOME OF ITS GEOCHEMICAL AND MINING-TECHNICAL IMPACTS,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 5C.
W88-01568

GROUND-WATER REACTIONS TO SURFACE COAL MINING IN SEMIARID LANDS,
Montana Bureau of Mines and Geology, Butte.
For primary bibliographic entry see Field 4C.
W88-01576

INFLUENCE OF MINING ON THE GROUNDWATER MINERALIZATION IN THE UPPER SILESIAN COAL BASIN,
Instytut Geologiczny, Sosnowiec (Poland). Upper Silesian Branch.
For primary bibliographic entry see Field 4C.
W88-01588

INDUSTRIAL WASTEWATER TREATMENT TECHNOLOGY,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W88-01598

DETERMINATION OF ORGANIC SUBSTANCES IN WATER,
For primary bibliographic entry see Field 5A.
W88-01599

DETERMINATION OF ORGANIC SUBSTANCES IN WATER,
For primary bibliographic entry see Field 5A.
W88-01600

FIELD FACILITIES FOR SUBSURFACE TRANSPORT RESEARCH,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2F.
W88-01605

DOE DEEP PROBE - FIELD EVALUATION AND PLANNING WORKSHOP,
Department of Energy, Washington, DC. Office of Health and Environmental Research.
F. J. Wobber, and J. M. Zachara.
Augusta Landmark Hotel, Augusta, Georgia, February 18-19, 1987. Report DOE/ER-0320.35 p, append.

Descriptors: *Microbiological studies, *Subsurface environment, *South Carolina, Geohydrology, Sediments, Deep probes, Cores, Core drilling, Soil properties, Soil water, Groundwater.

The results of an invited workshop in support of DOE's microbiology research program (Deep Probe) are described. Final decisions for strengthening the program and for future drilling were not expected from the workshop. Rather, a preliminary set of program recommendations and priorities were developed which will be redefined by small groups of scientific specialists in the near future. The major recommendations of the workshop are summarized. DOE's perspectives on tasks related to the following areas are presented: drilling and coring procedures; tracer technologies and issues of contamination; supplementary geohydrological, sedimentological and geological analysis relevant to analysis of deep microbial habitats; statistical analysis of existing samples; experimental design for future coring; improvements in microbiological sampling, core handling, and acquisition of pore water chemical samples; interlaboratory standardization of microbiological protocols; DOE's strategy for extension of the research to other hydrogeological regimes; and, accelerated information exchange with the scientific community. (Lantz-PTT)
W88-01607

CHARACTERISTICS OF BIG SANDY RIVER DRAINAGE BASIN WATER AND OF SALTY AQUIFER WATER,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 5E.
W88-01614

EFFECTS OF A BIOMODAL PORE DISTRIBUTION ON MATRIX DIFFUSION IN A FRACTURED POROUS MEDIUM,
Sandia National Labs., Albuquerque, NM. Earth Sciences Div.
D. Tomasko.
Available from the National Technical Information Service, Springfield, VA. 22161. Report No. SAND87-0265, August 1987. 28 p, 18 fig, 2 tab, 32 ref. DOE Contract No. DE-AC04-76DP00789.

Descriptors: *Porosity, *Groundwater movement, *Bimodal pore distribution, *Diffusion, *Path of pollutants, *Porous media, *Model studies, Solute transport, Dispersion, Mathematical studies.

Three models were developed for predicting the concentration of a conservative (nonreactive) solute during transport through a fractured porous medium consisting of two materials with different physical properties. The materials are assumed to be arranged in series along the fracture, so that the advecting fluid sequentially passes through two different matrix environments. In all cases, the matrices are assumed to be infinite in a direction perpendicular to the orientation of the fracture. The first model predicts the time-dependent solute concentration using two one-dimensional transport equations for the fracture and two one-dimensional diffusion equations for the rock matrices. Longitudinal dispersion in the fracture is assumed to be negligible. The fracture equations are coupled by assuming a constant concentration at the boundary between the two materials, and the fractures are coupled to the matrices by appropriate flux terms. In the second model, the number of equations required to predict the concentration of the solute in the fracture is reduced by a factor of 2 by developing simple, analytic expressions for a single, effective porosity and matrix-diffusion coefficient. The third model is much more complex than the first two because of incorporation of longitudinal dispersion in the fracture transport equations. This model was developed and used to investigate the effects of axial dispersion on the predicted concentrations and to determine when the simpler models are appropriate. Comparisons between the three models indicate that the predicted solute concentrations in a fracture for a constant source input are very similar except near the boundary between the two materials, where the maximum differences are approximately 20%. Even better results are obtained when the duration of the injection is short compared to the total time of the test. (Lantz-PTT)
W88-01658

HYDROGEOLOGIC EVALUATION OF THE EFFECTS OF SURFACE APPLICATION OF SEWAGE SLUDGE TO AGRICULTURAL LAND NEAR ROCKTON, ILLINOIS,
Illinois State Geological Survey, Urbana.
R. C. Berg, W. J. Morse, and T. M. Johnson.
Environmental Geology Notes 119, 1987. 42 p, 14 fig, 5 tab, 39 ref.

Descriptors: *Geohydrology, *Sludge disposal, *Land disposal, *Rockton, *Illinois, *Fate of pollutants, *Groundwater pollution, Monitoring, Groundwater movement, Path of pollutants, Nitrates, Chlorides, Nitrogen compounds, Sludge, Waste disposal.

A study of the geohydrology of sludge application areas in the sandy agricultural land near Rockton, Illinois was conducted to evaluate possible contamination of the groundwater by sludge constituents. Over a 2-year period, a total of 16 monitoring wells was installed at four sites. Two sites were characterized by repeated applications of sludge and two were background sites. Two soil water samplers were also installed at each sludge application area. The monitoring wells and soil water samplers were used to determine groundwater flow and quality. Samples were analyzed for nitrates, MBAS, chlorides, NH3N, pH, hardness, specific conductivity (SC), metals, and organic chemicals. Nitrates provided the most reliable data on the effects of sludge applications on groundwater quality. Nitrate concentrations were higher at sludge application sites than at background sites and higher in downgradient wells than in upgradient wells. Data from other analyses were not conclusive; however, elevated values of MBAS, chlorides, NH3N, pH, hardness, and SC in downgradient wells suggest some influence from sludge applications on the groundwater. There was no apparent contamination from metals or organic chemicals. (Author's abstract)
W88-01672

TRANSPORT OF CONTAMINANTS IN THE SUBSURFACE: THE ROLE OF ORGANIC AND INORGANIC COLLOIDAL PARTICLES.
Oak Ridge National Lab., TN. Environmental Sciences Div.
Summary Report of an International Series of Interactive Seminars, October 6-9, 1986, Manteo, North Carolina. Report No. DOE/ER-0331. 70 p, 4 fig, 54 ref, 2 append.

Descriptors: *Organic compounds, *Inorganic compounds, *Path of pollutants, *Groundwater pollution, *Colloids, Solute transport, Aquifers, Groundwater movement.

The purpose of the meeting was to review current knowledge about the role played by colloids on the mobility of contaminants in the subsurface environment, and to identify important long-term research needs in this area. Participants included senior researchers in this field from national laboratories, government agencies, universities, and research institutes in four countries. Recent findings on the occurrence and nature of colloidal material in the subsurface as well as on the association of colloids with organic, metal, and radionuclide contaminants were presented and discussed. Field studies have demonstrated that colloidal particles do move through aquifers and that radionuclides have been transported much further than predicted due to their association with mobile colloids in the groundwater. The consensus of the meeting was that colloids do occur in the subsurface environment, are capable of binding organic and inorganic contaminants, and do alter the mobility of contaminants. A major difficulty in understanding and predicting the role of colloids is their heterogeneous nature that hampers precise chemical characterization. Clay and metal oxide colloids can be formed or dissolved due to changes in solution chemistry in the aquifer. Organic colloids have variable and diverse functional groups, making it difficult to predict their association with metal and radionuclide contaminants. Some important advances were reported toward understanding the assembly of organic colloids and the nature of their interactions with organic contaminants. Major research needs identified by the participants included studies in real systems on the occurrence of colloids in subsurface environments, and more rigorous characterization of the physical and chemical properties of the colloidal material. Methods for sampling colloids need to be improved to avoid production of artifacts during collection. In summary, the meeting concluded that colloidal material is important in contaminant transport and that further research in this area will significantly improve today's capacity to predict the movement of energy-related contaminants in subsurface environments. (Author's abstract)
W88-01674

LABORATORY AND SIMULATION STUDIES OF SOLUTE TRANSPORT IN FRACTURE NETWORKS,
Idaho National Engineering Lab., Idaho Falls.
L. C. Hull, J. D. Miller, and T. M. Clemo.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1505-1513, August 1987. 11 fig, 27 ref. DOE Contract DE-AC07-76ID01570.

Descriptors: *Fracture permeability, *Groundwater movement, *Geologic fractures, *Path of pollutants, *Solute transport, *Mathematical models, *Model studies, Fate of pollutants, Solutes, Mathematical equations, Mathematical studies, Diffusion, Velocity, Simulation, Advection.

Physical and numerical network models were used to analyze the transport of conservative solutes in systems of parallel-sided fractures. The processes controlling dispersion in fracture systems that are explicitly simulated by the numerical model are: (1) development of a velocity profile within individual fractures, (2) transverse molecular diffusion between streamlines, both within fractures and at fracture junctions, and (3) advection with the bulk fluid through a system of fractures with a range of hydraulic gradients and apertures. The first two processes, referred to as microdispersion, are often assumed to be secondary to the third, referred to as macrodispersion. The validity of this assumption is, however, highly dependent on the hydrodynamics of the system under consideration. Data collected from a physical model of a fracture network are used to validate a numerical model that explicitly simulates all three transport processes. The numerical model is then used to evaluate the relevance of microdispersion processes in a system where macrodispersion is significant. (Author's abstract)
W88-01683

FIELD EVALUATION OF A SIMPLE MICROCOSM SIMULATING THE BEHAVIOR OF VOLATILE ORGANIC COMPOUNDS IN SUBSURFACE MATERIALS,
Robert S. Kerr Environmental Research Lab., Ada, OK.
J. T. Wilson, G. B. Smith, J. W. Cochran, J. F. Barker, and P. V. Roberts.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1547-1553, August 1987. 4 fig, 1 tab, 16 ref. EPA Grants CR-808851 and CR-811146. National Sciences and Engineering Research Council (Canada) Grant A7336.

Descriptors: *Groundwater pollution, *Volatile organic compounds, *Fate of pollutants, *Path of pollutants, *Field tests, Organic compounds, Comparison studies, Batch microcosm, Cleanup operations, Biotransformation, Degradation, Aquifer material, Simulation analysis.

A simple batch microcosm was previously developed to simulate the behavior of volatile organic compounds in unconsolidated subsurface material. The microcosm was evaluated by comparing the behavior of tetrachloroethylene, bromoform, carbon tetrachloride, 1,2-dichlorobenzene, and hexachloroethane in (1) the microcosm, (2) the microcosm constructed with autoclaved material, and (3) an experimental plume constructed in a joint field study conducted at Stanford University and the University of Waterloo at a site on Canadian Forces Base, Borden, Ontario. The microcosm study adequately simulated nonbiological removal of these compounds from solution in the experimental plume. However, it failed to detect biotransformation of 1,2-dichlorobenzene despite extensive degradation of this compound in the field. One of the samples of aquifer material used to construct the microcosms had a much greater capacity to biotransform bromoform and carbon tetrachloride than did the other samples of aquifer material or the aquifer in general. As a result, the microcosm study overestimated biotransformation of bromoform and carbon tetrachloride. The microcosm accurately simulated the behavior of tetrachlorethylene and hexachloroethane. (Author's abstract)
W88-01687

ANTHROPOGENIC ANOXIFICATION ('EUTROPHICATION') OF THE WATER TABLE REGION OF A DEEP PHREATIC AQUIFER,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
D. Ronen, M. Magaritz, E. Almon, and A. J. Amiel.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1554-1560, August 1987. 8 fig, 33 ref.

Descriptors: *Groundwater pollution, *Water pollution effects, *Fate of pollutants, *Eutrophication, *Dissolved oxygen, *Groundwater quality, *Oxygen depletion, Aquifers, Oxygen, Water table, Organic matter, Anaerobiosis, Organic load, Effluents.

Depletion of dissolved oxygen was detected at the water table region (upper 2.5 m) of a 30-m-deep, sandy, phreatic aquifer containing high oxygen concentrations (7.5 mg/liger) in bulk groundwater. Samples spaced at 3-cm intervals disclosed very sharp oxygen gradients of up to 1.9 mg/liter/cm between two consecutive samples. High concentrations of labile organic matter arrive at the water table region after a transport period of more than 15 years through the unsaturated zone. Part of the organic matter oxidizes at the water table region, as evidenced by the decrease in the dissolved oxygen content. The concentration of the remaining dissolved organic matter can be as high as 8 mg C/liter, decreasing with depth. The dissolved organic carbon derives from a large pool of water soluble organic matter found in the unsaturated zone. The average oxygen and organic carbon fluxes at the unsaturated-saturated interface are 0.085 mg O2 and 0.031 mg C sub org/sq cm/year, respectively. Anaerobiosis may result either from the high organic load (140 kg C sub org/hectare/year) provided by irrigation with sewage effluent since the 1960s or from the retarded influx of organic matter mobilized at the onset of the intensive agricultural development of the area in the 1930s. The high oxygen content in deep pumping wells and the positive correlation found between the depth of the reduced zone and the organic loads from sewage effluents support the first model. (Author's abstract)
W88-01688

TRANSPORT OF REACTING SOLUTES SUBJECT TO A MOVING DISSOLUTION BOUNDARY: NUMERICAL METHODS AND SOLUTIONS,
Geological Survey, Menlo Park, CA. Water Resources Div.
C. Willis, and J. Rubin.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1561-1574, August 1987. 11 fig, 2 tab, 31 ref, append.

Descriptors: *Solute transport, *Mathematical models, *Path of pollutants, *Dissolution, Model studies, Fate of pollutants, Mathematical studies, Mathematical equations, Boundary conditions, Moving dissolution boundaries, Boundary processes, Boundaries, Chemical reactions, Chemical precipitation.

A moving boundary problem which arises during transport with precipitation-dissolution reactions is solved by three different numerical methods. Two of these methods (one explicit and one implicit) are based on an integral formulation of mass balance and lead to an approximation of a weak solution. These methods are compared to a front-tracking scheme. Although the two approaches are conceptually different, the numerical solutions showed good agreement. As the ratio of dispersion to convection decreases, the methods based on the integral formulation become computationally more efficient. Specific reactions were modeled to examine the dependence of the system on the physical and chemical parameters. Although the water flow rate does not explicitly appear in the equation for the velocity of the moving boundary, the speed of the boundary depends more on the flux rate than on the dispersion coefficient. The discontinuity in the gradient of the solute concentration profile at the boundary increases with convection and with the initial concentration of the mineral. The presented implicit method is extended to allow participation of the solutes in complexation reactions as well as the precipitation-dissolution reaction. This extension is easily made and does not change the basic method. (Author's abstract)
W88-01689

USING THE METHOD OF MOMENTS TO ANALYZE THREE-DIMENSIONAL DIFFUSION-LIMITED SOLUTE TRANSPORT FROM TEMPORAL AND SPATIAL PERSPECTIVES,
Stanford Univ., CA. Dept. of Civil Engineering.
M. N. Goltz, and P. V. Roberts.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1575-1585, August 1987. 1 fig, 4 tab, 37 ref, append. EPA Agreement CR 808851.

Descriptors: *Solute transport, *Path of pollutants, *Model studies, *Mathematical models, Fate of pollutants, Mathematical equations, Diffusion, Dispersion, Advection, Mathematical studies, Distribution, Spatial distribution, Temporal distribution, La place equation, Fourier analysis.

The analysis and application of an analytical model that incorporates solute diffusion within immobile regions into the three-dimensional advection/dispersion solute transport equation were performed. The diffusion term of the model is formulated using either a first-order rate expression or an expression assuming Fickian diffusion into spherical, cylindrical, or rectangular immobile regions. In order to assist in the analysis of solute transport behavior by means of the models, a modified form of Aris' method of moments is developed, which permits the calculation of the spatial and temporal moments of solute distributions simulated using three-dimensional diffusion models, without having to invert the Laplace- or Fourier-transformed solutions. By using this method, the moments of the diffusion models are compared with one another, with the moments of a model that assumes equilibrium advective/dispersive transport, and with the moments of a model that assumes that a first-order rate law governs mass transfer between the mobile and immobile regions. The method of moments also is used to assess the differences in the spatial and temporal moment behavior of each transport model under discussion. (Author's abstract)
W88-01690

APPROXIMATE SEMIANALYTICAL SOLUTION FOR TRACER INJECTION TESTS IN A CONFINED AQUIFER WITH A RADIALLY CONVERGING FLOW FIELD AND FINITE VOLUME OF TRACER AND CHASE FLUID,
GeoTrans, Inc., Herndon, VA.
V. Guvanasen, and V. M. Guvanasen.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1607-1619, August 1987. 12 fig, 25 ref.

Descriptors: *Groundwater pollution, *Hazardous wastes, *Radioactive wastes, *Tracers, *Path of pollutants, *Confined aquifers, *Groundwater movement, Analytical solutions, Mathematical studies, Mathematical equations, Flow pattern, Solute transport, Dispersion, Tracking techniques.

An approximate analytical solution describing the movement of a conservative tracer of finite volume in a radially converging flow field is proposed. The solution is divided into two phases: injection and transport. During the injection phase, an injection of chase fluid immediately following the tracer is allowed. Hydrodynamic dispersion effects are assumed to be negligible during this phase. The geometry of the tracer plume is determined by a particle-tracking technique. During the plume phase, the tracer plume is approximated by a series of contiguous pulses. An approximate analytical solution for each pulse was derived through linearization of the transport equation. The approximate solution was verified by comparison with numerical solutions. The distribution of tracer in space and time is obtained by summing the contributions from all the pulses. Four geometrical parameters governing the geometry of the tracer plume immediately after injection are presented and discussed. The solution shows that the geometry of the initial tracer plume has an effect on the breakthrough curves. The volume of tracer and chase fluid must be taken into account in tracer test design and data analysis. Limitations of the proposed solution are also discussed. (Author's abstract)
W88-01692

LABORATORY EVIDENCE OF THE SCALE EFFECT IN DISPERSION OF SOLUTES IN POROUS MEDIA,
Notre Dame Univ., IN. Dept. of Civil Engineering.
S. E. Silliman, and E. S. Simpson.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1667-1673, August 1987. 8 fig, 1 tab, 17 ref. U.S. Nuclear Regulatory Commission NRC-04-78-275.

Descriptors: *Groundwater movement, *Groundwater pollution, *Solute transport, *Path of pollutants, *Porous media, *Sand, Scale effect, Mathematical equations, Mathematical studies, Laboratory tests, Dispersion, Tracers, Solutes.

Field observations by other authors indicate that dispersivity is dependent on distance from source. Tests were conducted under controlled laboratory conditions to investigate the changes in dispersivity caused by the presence of heterogeneities. The experiments were conducted in a 2.4 x 1.07 x 0.10 m 'sandbox' with measurements of tracer concentration taken at various distances from the input. Results for various sand-packing arrangements were as follows: (1) Breakthrough curves for a uniform coarse sand showed a constant dispersivity of approximately 0.02 m. (2) Breakthrough curves for a three-layer arrangement of coarse-fine-coarse deviated from the homogeneous results only in the late-time tails. (3) The middepth fine-sand layer was then replaced by small blocks of fine sand surrounded by coarse sand. Two distinct portions of the breakthrough curves could be identified: one for the coarse-sand matrix and one for the heterogeneous layer. (4) Small blocks of fine sand were uniformly distributed through the entire coarse-sand matrix. Results indicated a continuous increase in dispersivity with distance and a change in the shape of the breakthrough curve at each of five measurement sections. These results are in general agreement with several recent theoretical developments regarding transport. (Author's abstract)
W88-01698

AGRICULTURAL CHEMICALS IN GROUND WATER: SUGGESTIONS FOR THE ENVIRONMENTAL PROTECTION AGENCY STRATEGY,
Kansas State Univ., Manhattan. Inst. for Environ-

mental Research.
D. A. Shields.
Journal of Environmental Sciences JEVSAG, Vol. 30, No. 3, p 23-27, May/June 1987. 15 ref.

Descriptors: *Groundwater pollution, *Groundwater quality, *Agricultural chemicals, *Water quality control, *Path of pollutants, *Environmental Protection Agency, Fate of pollutants, Groundwater, Water quality, Pesticides, Nitrates, Regulations, Aldicarb.

Groundwater, a hidden resource whose volume is over 50 times that of the nation's surface water, was once thought to remain forever pure. People had little reason not to believe that the soil would naturally purify water returning to the aquifer until the late 1970s when the Love Canal and Times Beach incidents redirected public opinion and touched off a nationwide concern for the protection of groundwater. In August 1984, the Environmental Protection Agency (EPA) issued a Ground Water Protection Strategy which was designed to 'increase efforts to protect groundwater from pesticide and nitrate contamination.' In response, the EPA's Office of Pesticide Protection reviewed existing information on the extent and causes of pesticide contamination, its potential health hazards, existing statutory authorities, and programs available to aid state policy makers. An increased interest in solving problems associated with pesticides in groundwater has resulted in the EPA's current development of a national strategy on Agricultural Chemicals in Ground Water. This strategy will outline the EPA's general course of action in addressing the problem of pesticides in groundwater during the next 5-10 years. Suggestions to the EPA to be considered in the formulation of the strategy are presented. Several actions that could be taken by the EPA include: (1) providing small federal grants to university undergraduate research programs which would facilitate further development of chemical applicators that reduce potential groundwater contamination; (2) developing biotechnological alternatives that could provide a long-term solution; (3) addressing the aldicarb decision by considering the method used in Florida to curb aldicarb contamination of groundwater without unnecessary restrictions on farmers; and (4) defining uniform monitoring methods according to study goals. (Wood-PTT)
W88-01714

LEVELS AND AGES OF SELENIUM AND METALS IN SEDIMENTARY CORES OF ISE BAY AS DETERMINED BY 210-PB DATING TECHNIQUE,
Nagoya City Environmental Pollution Research Inst. (Japan).
K. Itoh, M. Chikuma, and H. Tanaka.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 2, p 214-223, August 1987. 3 fig, 2 tab, 12 ref.

Descriptors: *Path of pollutants, *Selenium, *Heavy metals, *Ise Bay, *Japan, Fate of pollutants, Sedimentary cores, Cores, Mercury, Zinc, Copper, Lead, Chromium, Bottom sediments, River mouth.

Input of selenium into Ise Bay, Japan, has occurred since industrial activity was established in Nagoya City. The metals present in sedimentary core samples of known age were determined in an attempt to investigate the age of the pollution. The distribution of selenium, mercury, zinc, copper, lead and chromium in the bottom sediments showed the largest amounts of the metals in the river mouth with metal quantity decreasing with increasing distance of the sample location from the river mouth. The values increased again slightly at the center of the bay. The vertical profiles of the six metals in several core samples were shown and the sedimentation rates were provided. Trends in the pollution levels of the metals were explained with respect to the history of industrial operations in the area. (Wood-PTT)
W88-01719

COMPARISON OF OCCURRENCE AND RATES OF CHEMICAL BIODEGRADATION IN NATURAL WATERS,
Wisconsin Univ.-Superior. Center for Lake Superior Environmental Studies.
D. D. Vaishnav, and L. Babeu.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 2, p 237-244, August 1987. 1 fig, 3 tab, 16 ref. USEPA Cooperative Agreement CR811603.

Descriptors: *Fate of pollutants, *Path of pollutants, *Chemical degradation, *Biodegradation, *Comparison studies, Degradation, Organic compounds, Aquatic environment, Microbial degradation, Groundwater, Lester River, Harbors.

In order to assess the biological effects of chemicals in aquatic environments, the fate of xenobiotic compounds entering natural waters through domestic and industrial effluents, agricultural runoff, seepages from surface and sub-surface chemical repositories, atmospheric deposition, and accidental spills must be understood. Biodegradation has been proposed as the principal mechanism which determines the lifetime of chemical pollutants, but it is the environment that actually controls the biodegradation process. A comparison of biodegradation for the same chemicals in diverse natural waters can not be readily made from the data of existing studies. Such comparisons would help improve the understanding of interactions between the environment, substrate and microorganisms, and may facilitate the transposition of laboratory data to the natural environment. Therefore, the degradation of ten organic chemicals by autochthonous microorganisms was measured and compared in groundwater, Lester River water and Superior Harbor water. The physicochemical characteristics were detailed for the three water sources and the extent of chemical biodegradation and duration of incubation were correlated for each type of water. Generally, chemicals were found to biodegrade more in the waters enriched with both nutrients and microbes than in those receiving either amendment alone. (Wood-PTT)
W88-01722

SEVENTH ANNUAL MADISON WASTE CONFERENCE: MUNICIPAL AND INDUSTRIAL WASTE.
Wisconsin Univ.-Madison. Dept. of Engineering and Applied Science.
For primary bibliographic entry see Field 5E.
W88-01725

USE OF MULTI-LEVEL GAS DRIVEN SAMPLERS AND CONVENTIONAL MONITORING WELLS FOR EVALUATION OF GROUNDWATER CONTAMINATION AT AN UNCONTROLLED HAZARDOUS WASTE SITE,
NUS Corp., Pittsburgh, PA.
For primary bibliographic entry see Field 5E.
W88-01726

MIGRATION AND DEGRADATION PATTERNS OF VOLATILE ORGANIC COMPOUNDS,
Warzyn Engineering, Inc., Madison, WI.
P. V. Cline, and D. R. Viste.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 14-29, 1 fig, 5 tab, 17 ref.

Descriptors: *Fate of pollutants, *Leaching, *Organic compounds, *Degradation, *Landfills, *Path of pollutants, Waste disposal, Hazardous materials, Organic solvents, Chlorinated hydrocarbons, Groundwater pollution, Geohydrology, Leachates, Biodegradation.

Studies were conducted at solvent recovery facilities, solid/hazardous waste landfills and solvent contamination sites near an industrial facility to study distribution trends of degradation products of volatile organic compounds. It was concluded that, when degradation occurs, the parent solvent compounds are at highest concentrations near the source. With distance from the source, proportions of degradation products increase. Degradation products are most fequently found near a source containing high concentrations of other organic compounds. These other organics may consist of organic material from a landfill, other non-chlorinated solvents, or high organic content in the soil. These organic compounds appear to increase the rate of parent solvent degradation. More complete degradation may occur in the upper portion of the zone of saturation than with depth in the aquifer. The chlorinated compounds, due to their high specific gravity, will sink through the aquifer when in excess of their solubility until they are adsorbed, dissolved, and/or reach an impermeable layer. Dissolved constituents move with the groundwater as dictated by the hydrogeology of an area. Standard analytical protocols for measuring volatile organic priority pollutants by GC/MS do not distinguish between a highly toxic priority pollutant and a significantly less hazardous non-priority pollutant degradation product, which is the dominant degradation contaminant present at these sites. Suggestions for applying this data to the design of specific site investigation programs and recommendations for presentation and analysis of data generated during solvent contamination studies are given. (See also W88-01725) (Geiger-PTT)
W88-01727

COMPARISON OF LABORATORY AND FIELD DETERMINED VALUES OF HYDRAULIC CONDUCTIVITY AT A WASTE DISPOSAL SITE,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 5E.
W88-01728

ASPECTS OF PHOSPHOGYPSUM WASTE DISPOSAL,
Steffen, Robertson and Kirsten, Inc., Vancouver (British Columbia).
For primary bibliographic entry see Field 5E.
W88-01733

PERSISTENCE OF SYNTHETIC SOLVENT CONTAMINANTS IN A GLACIAL OUTWASH AQUIFER, WASHINGTON STATE,
Environmental Protection Agency, Seattle, WA. Region X.
F. Wolf, and I. Gorelik.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 116-131, 4 fig, 3 tab, 8 ref, append.

Descriptors: *Groundwater pollution, *Organic solvents, *Water pollution treatment, *Sampling, *Kinetics, Aquifers, Path of pollutants, Mathematical models, Adsorption, Desorption, Waste disposal, Fate of pollutants, Groundwater movement, Pumping.

A quantitative approach to investigating the effect of pumping on the removal of pollutants from contaminated groundwater systems is presented. This method was applied to treat the concentration response data of 1,2 trans-dichloroethylehylene and tetrachloroethylene gathered during the December 1983 pump test, Well H-2 at the Lakewood site. The equations derived were used to obtain rough estimations for the process kinetics, the residence time of these compounds in the aquifer, the mass of these pollutants in the aquifer, and the retardation factor of 1,2 trans-dichloroethylene. While the method presented appears to be a useful approach in investigating the effect of pumping on the removal of pollutants from groundwater, its accuracy depends largely on the number of sampling points; the more sampling points there are, the longer the time interval, and the greater the accuracy of the analysis. (See also W88-01725) (Geiger-PTT)
W88-01734

REMEDIAL ACTION ASSESSMENT FOR HAZARDOUS WASTE SITES VIA NUMERICAL SIMULATION,
GeoTrans, Inc., Herndon, VA.
J. W. Mercer, C. R. Faust, R. M. Cohen, P. F. Andersen, and P. S. Huyakorn.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 132-147, 7 fig, 6 ref.

Descriptors: *Waste disposal, *Hazardous materials, *Fate of pollutants, *Mathematical models, *Simulation analysis, Design criteria, Groundwater movement, Flow profiles, Subsurface drains, Saturated flow, Monitoring, Chlorinated hydrocarbons.

For hazardous waste sites, design criteria for hydraulic controls must consider time frames of many years and monitoring systems that include only a few observations points. Because the design criteria for construction projects and remediation are so different, there is no assurance that hydraulic controls will work equally well for both applications. For hazardous waste sites, uncertainty in the effectiveness of hydraulic controls has led to the combined use of modeling and monitoring. This usage of modeling in assessing various remedial actions is demonstrated by presenting simulation results from four hazardous waste sites. Groundwater flow modeling is used to evaluate various combinations of drains, walls, and caps at the Lipari site in New Jersey. A variably-saturated flow model is applied to various combinations of a wall, cap, and drains considered for the Love Canal site in Niagara Falls, NY. A flow and transport model is applied to a purge well system to recover a chlorinated hydrocarbon spill in New England. Finally, an immiscible flow model is applied to the S-Area site, also in Niagara Falls, to evaluate the remediation necessary to prevent the downward movement of dense nonaqueous liquid. In all four applications emphasis is placed on the groundwater system response to the remedial action. The results of such simulations may be used in an iterative fashion to improve both remedial design and monitoring. (See also W88-01725) (Author's abstract)
W88-01735

PREVENTION AND CONTAINMENT OF HAZARDOUS/TOXIC MATERIALS SPILLS IN DEPARTMENT OF DEFENSE STORAGE AND HANDLING AREAS,
Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD.
For primary bibliographic entry see Field 5E.
W88-01736

TOXIC ORGANIC BEHAVIOR IN SLUDGE-AMENDED SOILS,
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
B. C. Fairbanks, and G. A. O'Connor.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 161-165, 3 tab, 3 ref. DOE Contract No. DE-AC04-76ET 33626.

Descriptors: *Sludge disposal, *Polychlorinated biphenyls, *Soil amendments, *Degradation, *Sorption, Volatility, Industrial wastes, Organic compounds, Land disposal, Adsorption, Clays, Loam, Waste disposal.

The sorption, degradation, and volatilization of two toxic organic chemicals, di(2-ethylhexyl)phthalate (DEHP) and polychlorinated biphenyls (PCBs), were examined in soils that were unamended, freshly amended, or preconditioned with gamma-irradiated sewage sludge. The concentration of these chemicals may be increased in soils via the addition of sewage sludge. The data showed that the environmentally beneficial processes of chemical sorption and degradation are increased by sludge. Sludge additions also decreased volatilization, the primary means of PCB contamination of plants. In no case did sewage sludge addition increase the environmental hazard of these toxicants in soils. (See also W88-01725) (Author's abstract)
W88-01737

LONG-TERM IMPACTS OF INDUSTRIAL WASTE CODISPOSAL IN LANDFILL SIMULATORS,
SCS Engineers, Inc., Covington, KY.
For primary bibliographic entry see Field 5E.
W88-01738

HEAVY METALS IN DRILLING MUDS: SEQUENTIAL EXTRACTABILITY AND EFFECT OF A SOLIDIFICATION PROCESS,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
M. A. Elrashidi, and L. R. Hossner.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 188-198, 1 fig, 2 tab, 15 ref.

Descriptors: *Heavy metals, *Drilling fluids, *Solubilty, *Land disposal, *Decontamination, Separation techniques, Cements, Silicates, Waste management, Chemical precipitation, Toxicity, Path of pollutants, Adsorption, Calcium carbonate.

The solubility of heavy metals present in potentially toxic amounts in one oil base (diesel oil) and two water base (sodium dichromate and potassium chloride) drilling muds were investigated. Ammonium acetate, DTPA, and HCl were used in a sequential extraction to evalute the solubility of Cr, Zn, Pb, Fe, Mn, Cu, Ni, and Cd in the muds. A solidification process which involves treatment of the mud with cement and sodium silicate to reduce heavy metal solubility, led to measurable changes in the physical and chemical properties of the muds. These changes were effective in decreasing the extractability of heavy metals such as Cr and Zn which were present in potentially toxic concentrations. Increasses in both pH and reacting surfaces from carbonates and sesquioxides of the solidified forms of mud were believed to inhibit the solubility of heavy metals. Adsorption of metals on surfaces of carbonates and sesquioxides as well as coprecipitation of metal hydroxides with silica to produce insoluble metal silicates are possible. (See also W88-01725) (Author's abstract)
W88-01739

FLY ASH DISPOSAL IN A LIMESTONE QUARRY: HYDROGEOCHEMICAL CONSIDERATIONS,
Detroit Edison Co., MI.
For primary bibliographic entry see Field 5E.
W88-01740

BENNETT'S QUARRY: A CASE STUDY OF AN IMMEDIATE REMOVAL OF PCB WASTES UNDER SUPERFUND,
Weston (Roy F.), Inc., Northbrook, IL. SPER Div.
For primary bibliographic entry see Field 5E.
W88-01741

CONTAINMENT OF IRON SULFATE FROM ABANDONED PICKLE LIQUOR PONDS INVESTIGATION, FEASIBILITY STUDY DESIGN AND CONSTRUCTION,
Donohue and Associates, Inc., Sheboygan, WI.
For primary bibliographic entry see Field 5E.
W88-01742

SOIL--AN UNCERTAIN MEDIUM FOR WASTE DISPOSAL,
Illinois State Geological Survey Div., Champaign.
L. R. Follmer.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 296-311, 2 fig, 1 tab, 15 ref.

Descriptors: *Landfills, *Waste disposal, *Leaching, *Hazardous materials, *Path of pollutants, *Land disposal, Soil horizons, Waste management, Infiltration, Leachates, Fate of pollutants, Waste dumps, Soil profiles, Soil types, Case studies, Weathering, Design criteria.

The experience of the Illinois State geological Survey in the last seven years at a hazardous waste disposal site located at Wilsonville, Illinois, has brought a focus to the problems that stem from a poor understanding or a poorly communicated understanding about soils as a suitable medium for waste disposal. In the design of the site, an engineering concept was employed to interpret that soils were suitable, based on standard engineering test borings, laboratory tests, and state-of-the-art design and regulations. However, contaminants have migrated at rates beyond expectations and the rates could not be rationalized with the engineering type of soil boring descriptions. Little regard was given to the pedological features which control many of hte natural properties of the geologic units. The physical features of the soil horizons (the complete zonation of the weathering profile) relate and explain much of the observed patterns of water and pollutant migration. (See also W88-01725) (Author's abstract)
W88-01746

HAZARDOUS WASTE DISPOSAL IN CRYSTALLINE ROCK,
Minnesota Waste Management Board, Crystal.
For primary bibliographic entry see Field 5E.
W88-01747

REGULATION OF UNDERGROUND CHEMICAL STORAGE TANKS IN THE SAN FRANCISCO BAY AREA,
California Regional Water Quality Control Board, Oakland. San Francisco Bay Region.
R. B. James, D. M. Eisenberg, and A. Oliveri.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 325-334, 2 fig, 4 ref.

Descriptors: *Groundwater pollution, *Hazardous materials, *Leaching, *Path of pollutants, *Decontamination, *Organic solvents, Chlorinated hydrocarbons, Storage tanks, Regulations, Monitoring, Fate of pollutants, Cleanup.

The report of a leak of trichloroethane (TCA), a solvent used in the microelectronics industry, from a major electronics company in San Jose, California in the fall of 1981 has resulted in the discovery of ninety-six similar incidents in the San Francisco Bay Region. Results of a survey conducted by the Regional Water Quality Control Board showed that nine public and numerous private water supply wells have detectable levels of solvents and three public wells are no longer suitable for municipal water supply. Studies are underway to determine the extent of migration of contaminants from the underground facilities and programs are being implementd to contain further migration and to clean up contaminants. The State of California in 1983 adopted legislation to inventory underground storage tanks and to implement a program for regulation of tanks storing hazardous materials including containment, monitoring and testing, closure and leak reporting of tanks. In some instances local agencies have adopted ordinances to regulate the storage and handling of hazardous materials. Conclusions drawn from the experience of the Regional Board suggest that monitoring wells and soil borings are quite effective in identifying sites that have subsurface contamination. Significant effort and expense will be required to remedy the results of releases which occurred prior to the existance of sufficient regulations on underground chemical storage. (See also W88-01725) (Geiger-PTT)
W88-01748

AVOIDING FAILURE OF LEACHATE COLLECTION SYSTEMS AT HAZARDOUS WASTE LANDFILLS,
Little (Arthur D.), Inc., Cambridge, MA. Hazardous Waste Management Unit.
For primary bibliographic entry see Field 5E.
W88-01749

SANITARY LANDFILL LINERS - AN OVERVIEW OF REGULATORY REQUIREMENTS AND ENGINEERING PRACTICES,
Land and Lakes Co., Park Ridge, IL.
For primary bibliographic entry see Field 5E.
W88-01750

DIFFUSIONAL TRANSPORT OF HAZARDOUS WASTE LEACHATE ACROSS CLAY BARRIERS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.

D. H. Gray, and W. J. Weber Jr.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 373-389, 10 fig, 1 tab, 21 ref.

Descriptors: *Path of pollutants, *Hazardous materials, *Leachates, *Clays, *Linings, *Solute transport, Diffusion coefficient, Permeability coefficient, Leaching, Mathematical models, Landfills, Groundwater pollution, Sorption.

The results of theoretical and experimental studies for estimating solute sorption characteristics, breakthrough times, and mass fluxes across clay barriers are presented. Factors that control solute movement across clay barriers under the combined influence of advective and diffusive mass transport are described. At low pore velocities characteristic of water movement through clayey deposits, solute transport is largely diffusion controlled. Preliminary theoretical analyses indicate that certain chemicals from hazardous waste landfills can break through compacted clay liners or clay slurry cut-off walls in a relatively short time, viz., less than ten years, in spite of a negative or counter hydraulic gradient. These theoretical findings are supported by pollution migration studies at several landfill sites where pollution fronts from solute diffusion have overwhelmed seepage flow in the underlying clay. Techniques are suggested for improving organic solute retardation (sorption) in compacted clay liners and clay slurry cut-off walls. (See also W88-01725) (Author's abstract)
W88-01751

DEVELOPMENT AND APPLICATION OF BATCH ADSORPTION PROCEDURES FOR DESIGNING EARTHEN LANDFILL LINERS,
Illinois State Geological Survey Div., Champaign.
W. R. Roy, C. C. Ainsworth, R. A. Griffin, and I. G. Krapac.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 390-398, 6 fig, 2 tab, 15 ref. EPA Contract No. R-810245-01.

Descriptors: *Adsorption, *Cadmium, Landfills, *Linings, *Soil types, *Path of pollutants, Waste disposal, Desorption, Magnesium, Calcium, Sodium, Phosphorus, Separation techniques, Design criteria, Loam, Physicochemical properties, Waste management, clays, Solute transport.

A standardized batch adsorption procedure is in the developmental stage. Its routine use and guidelines for the interpretation of results is being scientifically documented. Many physicochemical factors including competitive adsorption between solutes will affect these results. The amount of Cd adsorbed by one soil was found to be dependent on the soil:solution ratio used. This phenomenon was attributed to competitive interactions between Cd and desorbed Ca and Mg. Competitive interactions between Cd and Na and between As and P with different soil materials are also used as examples to demonstrate that this phenomenon can complicate the development of a standardized batch procedure as well as interpreting adsorption data. (See also W88-01725) (Author's abstract)
W88-01752

EVALUATION OF THE PERFORMANCE OF FOUR CLAY-LINED LANDFILLS IN WISCONSIN,
Wisconsin Dept. of Natural Resources, Madison. Bureau of Solid Waste Management.
For primary bibliographic entry see Field 5E.
W88-01753

DEMONSTRATION OF LANDFILL GAS ENHANCEMENT TECHNIQUES IN LANDFILL SIMULATORS,
SCS Engineers, Inc., Covington, KY.
For primary bibliographic entry see Field 5E.
W88-01755

PREDICTING THE OCCURRENCE OF RADON-222 IN NORTH CAROLINA GROUNDWATER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. P. Loomis, J. E. Watson, and D. J. Crawford-Brown.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 217170/AS. Price codes: A04 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Completion Report No. 230, May 1987. 52 p, 10 fig, 7 tab, 34 ref. Contract No. 14-08-0001-G1243. Project No. USGS G1243-03.

Descriptors: *Radon, *Radon-222, *Groundwater, *Well water, *North Carolina, Wells, Geologic formations, Crystalline rocks, Granites, Gneisses, Water supply wells.

The intent was to develop an understanding of some of the factors that affect the concentration of radon-222 (222Rn) in drinking water supplies of North Carolina. Data for this investigation were collected on a sample of 96 North Carolina public water supply wells. Water samples were collected and analyzed for 222Rn content. Data on well characteristics (discharge, specific capacity, depth, and casing length) were obtained from existing sources. Study results concluded that there is a distinct and statistically significant difference in the mean 222Rn concentrations of samples drawn from any given rock type. This study indicates that the highest 222Rn concentrations are likely to be found in supplies located in granites and gneisses within the Blue Ridge, Inner Piedmont, and Raleigh Belt regions. Regardless of the rock type/geologic region category, variability in subpopulations still is substantial. A fairly surprising finding of this study is the relative insignificance of discharge, specific capacity, depth, and casing length of wells as predictors of 222Rn concentrations. (Lambert-UNC, WRRI)
W88-01760

MODELING GROUNDWATER FLOW BY MEANS OF A HYBRID TRAJECTORY IMAGE, BOUNDARY INTEGRAL EQUATION METHOD,
Purdue Univ., Lafayette, IN. Dept. of Earth and Atmospheric Sciences.
For primary bibliographic entry see Field 2F.
W88-01762

SPATIAL DISTRIBUTION AND ANALYSIS OF GROUNDWATER NITRATE CONTAMINATION IN KALAMAZOO COUNTY, MICHIGAN,
Michigan State Univ., East Lansing. Center for Remote Sensing.
K. M. Kittleson, and R. L. Kruska.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 217212/AS. Price codes: A03 in paper copy, A01 in microfiche. Michigan Institute of Water Research, E. Lansing. Technical Report No. G1232-04, March 1987. 26 p, 8 fig, 5 tab, 17 ref, append. Contract No. 14-08-0001-G1232. Project No. USGS G1232-04.

Descriptors: *Nitrates, *Geographic information systems, *Data acquisition, Groundwater, Water quality, Well logs, Kalamazoo County, Michigan, Database management, Water pollution sources.

A microcomputer-based groundwater management system has been developed that links existing water quality and well log information to a geographic information system (GIS) for Kalamazoo County, Michigan. Database management software is utilized to organize and selectively choose data for conversion into the GIS. Surfacing software is utilized for point data interpolation with raster file outputs. Existing map information was digitized and converted to converted to raster files for inclusion in the Kalamazoo County database. Surfacing was applied to groundwater nitrate point data to illustrate the spatial distribution of the contaminant in groundwater throughout the county. Nitrate levels are above the drinking water standard for 6.1% of the county (>10.0 ppm nitrate-nitrogen), and between 5.0 and 10.0 ppm nitrate-nitrogen for 16.7% of the county. Surfacing was also applied to well log information to produce raster data layers including depth to static water level and elevation of the static water level. (MI State U.)
W88-01763

HERBICIDE LEVELS IN RIVERS DRAINING TWO PRAIRIE AGRICULTURAL WATERSHEDS (1984),
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, and N. P. Grift.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 22, No. 3, p 259-284, June 1987. 4 fig, 3 tab, 28 ref.

Descriptors: *Herbicides, *Runoff, *Agricultural runoff, *Agricultural watersheds, *Pollutant identification, *Turtle River, *Ochre River, Agriculture, Water pollution sources, Canada, Prairies, MCPA, Monitoring, Diclofop-methyl, Dicamba, Bromoxynl, 2,4-D triallate, Trifluralin.

A monitoring survey was conducted during 1984 on the Ochre and Turtle Rivers, which flow into Dauphin Lake in western Manitoba, Canada, to determine levels of the herbicides MCPA, diclofop-methyl, dicamba, bromoxynil, 2,4-D, triallate and trifluralin which were widely used in each watershed. Triallate concentrations exceeded 4 ng/L in 50% and 10% of the 21 samples taken from each of the Turtle and Ochre River, respectively, during the period March to October 1984. Trifluralin concentrations exceeded 3 ng/L in 14% and 10% of the samples from the respective rivers. Maximum concentrations did not exceed 25 ng/L and were unrelated to changes in river flow. Bromoxynil and diclofop were detected in the Turtle River, at concentrations of 113 and 476 ng/L respectively, following a major high water event in late June, but were undetectable (< 2 and 12 ng/L, respectively) at other sampling times. Dicamba and 2,4-D were detectable throughout most of the sampling period in both rivers at low levels (< 100 ng/L). High levels of dicamba and 2,4-D (5476 and 2568 ng/L, respectively) were found in Turtle River water prior to the high water event possibly caused by the spraying of ditches or rights-of-way near the river. Discharges (g/year) of all 7 herbicides monitored represented less than 0.1% of the amounts estimated to be used in each watershed. Unit loadings (mg/ha/yr) of 2,4-D and dicamba were similar to those reported for Southern Ontario streams in the mid-1970's. The results indicate that herbicide contamination of Manitoba streams draining agricultural areas is generally low except when major runoff occurs during the application period in May and June. (Author's abstract)
W88-01800

OCCURRENCE OF PRECURSORS AND N-ALKYL-N-NITROSO COMPOUNDS,
National Swedish Environment Protection Board, Solna.
For primary bibliographic entry see Field 5C.
W88-01821

2,2-DIBROMO-3-NITRILOPROPRIONAMIDE (DBNPA) CHEMICAL DEGRADATION IN NATURAL WATERS: EXPERIMENTAL EVALUATION AND MODELING OF COMPETITIVE PATHWAYS,
Dow Chemical U.S.A., Midland, MI. Health and Environmental Sciences.
F. A. Blanchard, S. J. Gonsior, and D. L. Hopkins.
Water Research WATRAG, Vol. 21, No. 7, p 801-807, July 1987. 3 fig, 2 tab, 9 ref.

Descriptors: *Chemical reactions, *2,2-Dibromo-3-Nitrilopropionamide, *Model studies, *Degradation, *Fate of pollutants, Organic carbon, Toxicity, Path of pollutants, Chemical wastes, Computer models.

An important environmental feature of 2,2-dibromo-3-nitrilopropionamide (DBNPA), the active ingredient in Dow's Antimicrobials 7287 and 8536 is that the compound rapidly degrades in dilute aqueous solutions. High performance liquid chromatography analyses of ppm-concentrations of DBNPA and its degradation products in laborato-

ry tests of several natural water samples were used to follow the reactions involved. A hydrolysis pathway leads to dibromoacetonitrile (DBAN) and other products. The presence of organic material in the water leads to degradation by a second pathway in which monobromonitrilopropionamide (MBNPA) and several other degradation products are formed. From the data, a computer simulation model of the reactions has been developed using DACSL (Dow Advanced Continuous Simulation Language). The model describes quantitative relationships of DBNPA dosage and the natural water's organic material content, as measured by total organic carbon (TOC), in the degradation pathways of DBNPA. The model helps interpret the aquatic toxicity of the rapidly changing complex mixture produced during these degradations. Simulations of the DBNPA treatment of cooling towers were compared to limited experimental data which indicated that most of the degradation occurred by the pathway which produced the less toxic products (MBNPA rather than DBAN). (Author's abstract)
W88-01840

USE OF A VACUUM FILTRATION TECHNIQUE TO STUDY LEACHING OF INDIGENOUS VIRUSES FROM RAW WASTEWATER SLUDGE,
Health Effects Research Lab., Cincinnati, OH.
C. J. Hurst, and D. A. Brashear.
Water Research WATRAG, Vol. 21, No. 7, p 809-812, July 1987. 1 fig, 3 tab, 16 ref.

Descriptors: *Path of pollutants, *Vacuum filtration, *Viruses, *Sludge, *Leaching, *Waste disposal, Microbiological studies, Statistical analysis.

The relative efficiencies of a buffered beef extract solution, sewage secondary effluent, and distilled water, were compared in a study designed to simulate leaching of indigenous enteric viruses from raw primary sewage sludge. The initial sludge liquid fractions, termed sludge liquor, and leachates from five successive washings with one of the three test fluids were removed from the sludge samples by vacuum filtration through stainless steel mesh screens. The highest calculated efficiency for virus leaching was 2.8 + or - 1.4% obtained with the beef extract solution. This indicated leaching to be a very inefficient process and may suggest that viruses present in sewage sludges will remain highly solids-associated following land disposal. The ratio of indigenous viruses in the leachates vs. sludge liquor, for any particular sample, was statistically dependent upon the square of the sludge samples original percentage solids content. Together, the developed leaching technique and statistical equation provide a simple way to compare the relative amounts of leachable viruses present in samples of raw wastewater sludge. (Author's abstract)
W88-01841

OIL CONTAMINATION OF RAPTORS MIGRATING ALONG THE RED SEA,
For primary bibliographic entry see Field 5C.
W88-01857

MEASUREMENT OF THE MASS ACCOMMODATION COEFFICIENT OF SO2 (G) ON WATER DROPLETS,
Boston Coll., Chestnut Hill, MA. Dept. of Chemistry.
J. A. Gardner, L. R. Watson, Y. G. Adewuyi, and P. Davidovits.
Journal of Geophysical Research (D) JGRDE3, Vol. 92, No. 9, p 10887-10895, September 20, 1987. 3 fig, 3 tab, 25 ref. Coordinating Research Council Contract No. CAPA-21-80(2084), EPRI Contract No. RP 2023-8, NSF Grant No. ATM-8400748, and EPA Contract No. CR 812296-01-0.

Descriptors: *Mass accomodation efficient, *Chemical reactions, *Path of pollutants, *Acid rain, *Sulfate, Sulfur dioxide, Clouds, Fog, Hydrolysis, Chemical analysis.

Heterogeneous reaction pathways involving water droplets in clouds and fogs are important mechanisms for the chemical transformation of atmospheric trace gases. One of the fundamental parameters which determines the transfer rate of gases into aqueous droplets is the mass accomodation or 'sticking' coefficient for gas molecules on the droplet surfaces. A laboratory method for directly determining mass accomodation coefficients (gamma) has been developed, and applied to SO2. The method combines a monodisperse droplet stream, generated at a vibrating orifice, with a low-pressure flow reactor. The uptake of the trace gas by the droplets is determined by measuring changes in gas phase concentrations, using tunable diode laser absorption, as the droplet stream is turned on and off. Results for SO2 give a value of gamma = (5.4 + or - 0.6) times 10 to the -2nd at room temperature (295 K). However, this observed value of gamma is likely a lower limit to the true mass accommodation coefficient because of limitations imposed by the rate of gas phase diffusion of SO2 to the droplets and by the rate of hydrolysis of SO2 at the droplet surface. This measurement indicates that SO2 transport into clean aqueous cloud and fog droplets will not be limited by interfacial mass transport under normal atmospheric conditions. (Author's abstract)
W88-01859

INTERACTIONS OF PHTHALATE ESTERS WITH SUSPENDED PARTICULATE MATERIAL IN FRESH AND MARINE WATERS,
Liverpool Univ. (England). Dept. of Oceanography.
L. A. Al-Omran, and M. R. Preston.
Environmental Pollution EPEBD7, Vol. 46, No. 3, p 177-186, 1987. 4 fig, 2 tab, 11 ref.

Descriptors: *Path of pollutants, *Phthalate esters, *Particulate matter, Marine environment, Adsorption, Salts, Particle size, Chemical analysis, Lipids.

The behavior of six phthalate esters in the presence of particulate material suspended in fresh and saline water was examined. The adsorption of all phthalates by the particulates is enhanced by the presence of salt. The adsorption process is fairly rapid (<2-3 hr) and the degree of adsorption depends on the characteristics of the particulates. Diethylhexyl phthalate is adsorbed most actively by material of a small particle size. The adsorption of other phthalates is more strongly influenced by the chemical composition of the particulates and is most closely correlated with their lipid content. (Author's abstract)
W88-01862

BIOCONCENTRATION AND METABOLISM OF DDT, FENITROTHION AND CHLORPYRIFOS BY THE BLUE-GREEN ALGAE ANABAENA SP. AND AULOSIRA FERTILISSIMA,
Sri Venkateswara Univ., Tirupati (India). Dept. of Zoology.
S. Lal, R. Lal, and D. M. Saxena.
Environmental Pollution EPEBD7, Vol. 46, No. 3, p 187-196, 1987. 8 tab, 24 ref.

Descriptors: *Fate of pollutants, *Bioconcentration, *DDT, *Fenitrothion, *Path of pollutants, *Chlorpyrifos, *Algae, Aulosira fertilissima, Bioaccumulation, Insecticides, Organic pesticides.

Anabaena and Aulosira fertilissima showed a marked ability to accumulate DDT, fenitrothion and chlorpyrifos. Although the maximum accumulation of DDT was almost the same in both organisms, there were significant differences in their abilities to accumulate fenitrothion and chlorpyrifos. Patterns of uptake of DDT under different treatments were also similar in both Anabaena and Aulosira, but there were significant differences in the patterns of accumulation of fenitrothion between these two organisms. In Aulosira the maximum accumulation of fenitrothion was observed on the second day, whereas, in Anabaena, maximum accumulation was noticed on the first day. A completely different pattern of accumulation of chlorpyrifos was observed in Aulosira, which continued to accumulate chlorpyrifos throughout the experimental period. Bioconcentration of DDT in Anabaena and Aulosira ranged from 3 to 1568 ppm (micrograms/gm) and 6 to 1429 ppm, respectively. Bioconcentration of fenitrothion and chlorpyrifos in Anabaena varied from 53 to 3467 ppm and 7 to 6779 ppm, respectively. In Aulosira the bioconcentration varied from 100 to 6651 ppm and 53 to 3971 ppm for fenitrothion and chlorpyrifos, respectively. Anabaena and Aulosira metabolized DDT to DDD and DDE. Amounts of these DDT metabolites detected in the organisms were dependent on the concentration of treatment. DDD was the major, and DDE the minor, metabolite. These organisms were not able to metabolize the organophosphorus insecticides, fenitrothion and chlorpyrifos. (Author's abstract)
W88-01863

MEASUREMENT OF FLUORESCENCE DECAY OF CRUDE OIL: A POTENTIAL TECHNIQUE TO IDENTIFY OIL SLICKS,
Kuwait Univ., Safat. Dept. of Physics.
M. E. Abu-Zeid, K. S. Bhatia, M. A. Marafi, Y. Y. Makdisi, and M. F. Amer.
Environmental Pollution EPEBD7, Vol. 46, No. 3, p 197-207, 1987. 7 fig, 2 tab, 11 ref. Kuwait Environment Research Council Grant No. EPC004.

Descriptors: *Fate of pollutants, *Oil pollution, *Fluorescence decay, *Oil characterization, Photons, Lasers, Chemical analysis, Physicochemical properties, Oil spills.

The single photon counting technique has been used to measure the decay time for several Kuwaiti crude and refined oils. Fluorescent characteristics of two different bunker oils from widely separate geographic areas have been studied. Laser induced fluorescent data for the crude oil samples are compared with the decay time results to evaluate the potential of these techniques for the identification of oil slicks in the marine environment. Response of the oil film thickness to various excitation wavelengths from a CW Ar ion laser and a pulsed xenon lamp has been investigated. These experiments have shown that proper identification is best achieved by combining the fluorescence spectra with its decay time signature. Systematic research is necessary to acquire a data bank for the spectra and decay time parameters. Quantification of the oil slicks is possible by remote monitoring of the oil film's thickness, using more than one excitation wavelength. (Lantz-PTT)
W88-01864

DEVELOPMENT OF A MATHEMATICAL EUTROPHICATION MODEL OF THE LAGOON OF VENICE,
Venice Univ. (Italy). Dept. of Spectroscopy, Electrochemistry and Physical Chemistry.
C. Dejak, I. M. Lalatta, L. Meregalli, and G. Pecenik.
Ecological Modelling ECMODT, Vol. 37, Nos. 1/2, p 1-20, June 1987. 7 fig, 35 ref.

Descriptors: *Mathematical models, *Water pollution effects, *Lagoons, *Path of pollutants, *Eutrophication, *Venice, Advection, Diffusion, Mixing, Tidal effects, Nutrients, Phytoplankton, Zooplankton, Ammonia, Nitrates, Phosphates, Dissolved oxygen, Organic compounds, Temperature.

Integrated research on pollution and eutrophication problems in the central part of the lagoon of Venice is reported, together with a three-dimensional diffusion model. The latter was developed through preliminary elaboration of two other two-dimensional models of the same area, a diffusion and an advection-diffusion model. It was used to estimate, by calibration, the eddy diffusion constant incorporating the dispersive action of the tide. Both research and model were finalized with the objective of studying the temporal evolution and steady-state condition of the dispersion of pollutants and nutrients in the lagoon. The three-dimensional model is applied to simulate dispersion of eight representative variables: phytoplankton, zooplankton, NH4(+), NOx(-), PO3(3-), dissolved oxygen, degradable organic compounds and temperature. Computer outputs, displaying the spatial distribution of the considered variables under peculiar hypereutrophic conditions are presented. Additional detailed notes are introduced concern-

ing the more relevant steps of the global study. (Author's abstract)
W88-01873

TWO-DIMENSIONAL DIFFUSION MODEL OF THE VENICE LAGOON AND RELATIVE OPEN BOUNDARY CONDITIONS,
Venice Univ. (Italy). Dept. of Spectroscopy, Electrochemistry and Physical Chemistry.
C. Dejak, I. M. Lalatta, E. Messina, and G. Pecenik.
Ecological Modelling ECMODT, Vol. 37, Nos. 1/2, p 21-45, June 1987. 7 fig, 30 ref, append.

Descriptors: *Mathematical models, *Venice, *Lagoons, *Path of pollutants, Fate of pollutants, Diffusion, Boundary conditions, Computer programs.

A model study aimed at describing the multidimensional diffusion of pollutants in the central part of the lagoon of Venice is presented. After a preliminary search for analytical solutions, a first numerical two-dimensional diffusion model is developed which is capable of undergoing further extension. An original solution is proposed for conditions at the 'open' boundaries, i.e., boundaries derived from restricting the modelled area and not from real physical delimitations; a delocalized Gaussian distribution involving an analysis with logarithmic finite differences was found to be the optimal solution. An appendix is included, in which procedures followed to solve the problem are described and an analysis is performed of the many possible physico-mathematical expressions used in dealing with this problem. The computer program is also described; results obtained with the proposed boundary conditions conform to reality better than do those yielded by commonly adopted methods. (Author's abstract)
W88-01874

ADVECTION-DIFFUSION POLLUTION MODEL OF THE LAGOON OF VENICE,
Venice Univ. (Italy). Dept. of Spectroscopy, Electrochemistry and Physical Chemistry.
C. Dejak, I. M. Lalatta, E. Messina, and G. Pecenik.
Ecological Modelling ECMODT, Vol. 37, Nos. 1/2, p 47-57, June 1987. 5 fig, 13 ref.

Descriptors: *Path of pollutants, *Model studies, *Lagoons, *Venice, Mathematical models, Mixing, Tidal effects, Advection, Diffusion.

A two-dimensional advection-diffusion model of the central part of the Venice Lagoon, developed from a pre-existing pure diffusive model is presented. Tidal-current velocities are expressed with a time-dependent sinusoidal function multiplied by the sum of two vectors directed to the Lido and Lalamocco mouths and with magnitudes inversely proportional to the distances between nodal points and both sea entrances. In consideration of its physical meaning, the explicit second 'upstream' method is adopted for integration, whereas the calculation of intracell advective-diffusive flux is performed, taking the depth of the shallower of two adjacent cells into account. The consistency and stability of the method are thoroughly examined and compared with those of other methods; Reynold's cell number and conservativity are also discussed, as well as transportivity. Although operative, the model requires a lengthy computation time to achieve the steady state; future refinements and modifications leading to improvement are suggested. (Author's abstract)
W88-01875

STEADY-STATE ACHIEVEMENT BY INTRODUCTION OF TRUE TIDAL VELOCITIES IN A POLLUTION MODEL OF THE VENICE LAGOON,
Venice Univ. (Italy). Dept. of Spectroscopy, Electrochemistry and Physical Chemistry.
C. Dejak, I. M. Lalatta, E. Messina, and G. Pecenik.
Ecological Modelling ECMODT, Vol. 37, Nos. 1/2, p 59-79, June 1987. 11 fig, 19 ref.

Descriptors: *Tidal effects, *Path of pollutants, *Model studies, *Lagoon, *Venice, Tidal currents, Mathematical models, Diffusion, Mathematical studies, Eddy diffusion.

Data on the velocities of tidal currents to be used as input for an advection-diffusion model of the central part of the Venice Lagoon were obtained through interpolation by means of a pre-existing hydrodynamic model. Problems discussed include interpolating procedure and choice of points to calculate velocity vectors for the integration formula 'donor cell', as well as the least square optimization of both position and mutual orientation of the two grids. Using interpolated velocities, a steady state was attained after about forty semidiurnal tidal cycles; spatial distributions of pollutant at different tidal stages, as well as their arithmetic mean, are reported. Concentration profiles of the averaged distribution are substantially similar to those caused by a pure eddy-diffusion process originating from an apparent source spatially shifted from the real one. Causes for the shift are analyzed and the development of a three-dimensional diffusion model is anticipated, with tide-vorticity embodying an eddy-diffusion constant, calibrated upon the achieved steady state. The effect of 'numerical diffusion' is also discussed: this effect, in spite of the rather high Reynold's cell number involved in the numerical integration, is shown to be negligible in real circumstances. (Author's abstract)
W88-01876

TIDAL THREE-DIMENSIONAL DIFFUSION IN A MODEL OF THE LAGOON OF VENICE AND RELIABILITY CONDITIONS FOR ITS NUMERICAL INTEGRATION,
Venice Univ. (Italy). Dept. of Spectroscopy, Electrochemistry and Physical Chemistry.
C. Dejak, I. M. Lalatta, M. Molin, and G. Pecenik.
Ecological Modelling ECMODT, Vol. 37, Nos. 1/2, p 81-101, June 1987. 10 fig, 20 ref.

Descriptors: *Path of pollutants, *Model studies, *Diffusion, *Lagoons, *Venice, Numerical analysis, Mathematical models, Eddy diffusion.

A three-dimensional model of the central part of the Venice Lagoon is of a pure eddy-diffusion type and embodies tidal mixing action on pollutant transport. The model's asymptotic evolution to the steady state is examined, and it is shown that a pure diffusive process can achieve stationarity only in a system having more than two dimensions. Stability and consistency analysis of the implicit integration methods indicates that the two-time-levels Laasonen scheme is the most suitable for performing the integrations. Because of the closed vertical boundaries and the larger vertical diffusion number in respect to the horizontal, in a first version of the model Laasonen's scheme is adopted for only vertical diffusion. After solving the problems posed by non-linear conditions at the 'open' boundaries, the scheme was applied also for diffusion along all spatial coordinates. The diffusion constant adopted in the model was obtained by calibration with a previously developed advection-diffusion model. Utilization of the model for description of more complex interconnected physico-chemical, biochemical and ecological processes is prospected. (Author's abstract)
W88-01877

BACTERIAL SURVEY OF WELL WATER - TEHRAN, IRAN,
Tehran Univ. (Iran). School of Pharmacy.
For primary bibliographic entry see Field 7B.
W88-01880

FROM HOES TO HERBICIDES: AGRICULTURE AND GROUNDWATER QUALITY,
Iowa State Geological Survey, Iowa City.
G. R. Hallberg.
Journal of Soil and Water Conservation JSWCA3, Vol. 41, No. 6, p 357-366, November-December, 1986. 86 ref.

Descriptors: *Water pollution sources, *Herbicides, *Groundwater pollution, Agricultural runoff, Pesticides, Nitrates, Fertilizers, Public health, Groundwater quality, Drinking water, Nonpoint pollution sources.

Agriculture's impacts on groundwater quality have become an important environmental issue. Countless newspaper and magazine headlines, congressional hearings, a myriad of technical and policy meetings, and various industry and government agency activities all attest to this fact. More than half of the people in the United States use groundwater for drinking water. In grain-belt states the percentage is far greater. These problems affect the farm family first and foremost. In the grain belt, nearly all rural residents drink groundwater - untreated and unmonitored. Groundwater problems are bringing agricultural nonpoint source pollution and environmental problems 'home to roost' on the farm. The role of agriculture and fertilizer nitrogen in the leaching of nitrate to groundwater has been debated for some time. Numerous studies on various scales, from controlled plot studies to basin-wide inventories, have shown that nitrate concentrations in groundwater (shallow, freshwater aquifers) can be related directly to agricultural land use. Many of these studies show a range from a threefold to a sixtyfold increase in nitrate concentrations in groundwater between forested-pasture-grassland areas (generally < 2 million gm/L nitrate-nitrogen) and nearby, intensively cultivated and fertilized areas (commonly > 5 mg/L, ranging to more than 100 mg/L nitrate-nitrogen). Many studies show a direct relationship between nitrate leaching to groundwater and nitrogen fertilization rates and/or fertilization history. Nitrogen losses in economic terms, pesticides in groundwater, and public health concerns are further discussed in an attempt to understand difficulties relating groundwater pollution and agricultural runoff. (Lantz-PTT)
W88-01882

SURVIVAL OF FATHER RHINE,
Michigan Univ., Ann Arbor. School of Public Health.
R. A. Deininger.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 7, p 78-83, July 1987. 6 fig, 2 tab, 3 ref.

Descriptors: *Rhine River, *Basel, *Switzerland, *Path of pollutants, *Water quality, *Industrial wastes, Fate of pollutants, Germany, Ecological effects, Fish, Aquatic environment, Water pollution control.

A fire at a chemical manufacturing plant near Basel, Switzerland, in November 1986 released tons of toxic material into the vital Rhine River, killing hundreds of thousands of fish and affecting other aquatic life. Although the response to the accident was not immediate, Europeans were well prepared. The plume of contamination was systematically monitored as it descended past Germany and France to the Netherlands. Drinking water utilities were prepared to shut down intakes, if necessary, because the Rhine water is pretreated and allowed to settle for days in wells before final treatment and distribution. Actual damage from the spill was thus limited, and the river recovered within a week of the accident. Water utilities in the United States are advised to take comparable precautions if supplies from similar industrialized river basins are used. (Author's abstract)
W88-01891

DEVELOPING MODELS FOR PREDICTING TRIHALOMETHANE FORMATION POTENTIAL AND KINETICS,
Arizona Univ., Tucson. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W88-01893

DEAD ENDS, RED WATER, AND SCRAP PILES,
For primary bibliographic entry see Field 5F.
W88-01896

PASSAGE OF WASTE DISCHARGES THROUGH BLOCKS WITH VERTICAL UNITS,
Y. S. Vasil'ev, A. K. Minigulov, and I. S.

Samorukov.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 12, p 678-680, June 1987. 3 fig, 5 ref. Translated from Gidrotekhnische Stroitel'stro, No. 12, December 1986.

Descriptors: *Path of pollutants, *Waste disposal, Water pollution sources, Hydroelectric plants, Mathematical studies, Hydraulic head, Turbines, Gates.

In a low-head hydroelectric station, the need arises for the release of waste discharges through the waterways of turbine blocks. Such waste discharges are forced, promoting preservation of the hydraulic structures of the hydrostation. Problems of using the powerhouse of a low-head hydrostation for partial passage of flood wastewaters of low probability were studied, with the main purpose to determine the possibility of waste discharges of water through turbine blocks during construction of a hydro-development, or during its temporary operation, until the hydrostation was brought to design capacity and nominal operating conditions of the turbine equipment. The passage of waste discharges through the waterway of a turbine-generator unit block with the turbine runner or blades disassembled is an acceptable scheme in the operating period of a hydrostation when repairing the unit. In this case study, the maximum discharge capacity of the turbine block for gate apparatus (alpha o sub max), design head (H sub d) is Q = 1.62Q sub max (for the disassembled turbine runner) and Q = 1.65Q sub max (for the disassembled runner blades), where Q is the discharge. The maximum discharge capacity in the case of a unit assembled blade system is also obtained for alpha o sub max. However, passage of the waste discharge while preserving the rotational speed of the unit close to the nominal is possible only for small heads H = 0.35-0.54. The presence in the waterway of an additional resistance in the form of gates in the outlet diffuser of the draft tube, makes it possible to pass waste discharges Q = (1-1.2)Q sub max, with a wide range of heads acting on the hydrostation H = (0.35-1.3)H sub d while preserving the rotational speed of the unit close to the nominal N sub t = (0.9-1.1)n sub n. An additional check of the indicated variants, with an investigation of the strength of individual elements and components of the turbine block for particular conditions of the hydropower plant, is necessary for a final recommendation of the scheme of passing waste discharges through the powerhouse part of a hydrodevelopment. (Lantz-PTT)
W88-01901

ESTIMATES OF ACIDIFICATION OF LAKES IN THE MT. ZIRKEL WILDERNESS AREA, COLORADO,
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 5A.
W88-01915

CONVECTIVE TRANSPORT WITHIN STABLE RIVER SEDIMENTS,
Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2J.
W88-01916

CRITICAL CHEMICAL REACTION RATES FOR MULTICOMPONENT GROUNDWATER CONTAMINATION MODELS,
Toledo Univ., OH. Dept. of Civil Engineering.
A. A. Jennings.
Water Resources Research WRERAQ, Vol. 23, No. 9, p 1775-1784, September 1987. 12 fig, 3 tab, 17 ref. USDOE Contract DE-AC02-79EV10253.

Descriptors: *Path of pollutants, *Fate of pollutants, *Mathematical models, *Model studies, *Chemical reactions, *Groundwater pollution, Chemical reaction rates, Multicomponent systems, Prediction, Mathematical equations, Chemical equilibrium.

A method for determining the validity of the Local Equilibrium Assumption (LEA) for multicomponent contamination models is presented. The LEA may be justified only when interaction rate coefficients are large enough to force solutions of kinetic models to be indistinguishable from their pointwise equilibrium counterparts. When rate constants are not sufficiently large, LEA models can yield large prediction errors. A pulse error method is presented that offers more easily interpreted and less functionally complex measures of LEA error than existing procedures. Pulse error measures are also well conditioned for the questions most often asked of groundwater contamination models (arrival times and arrival concentrations at strategic downstream points). Nondimensional results for 1:1 ion exchange are presented to illustrate how pulse error analysis may be used to establish critical Damkohler number constraints for classes of interaction mechanisms. For the example problem discussed, the Damkohler number constraint (Da sub r $>$ 100) appears to be more stringent than previously reported. (Author's abstract)
W88-01918

EXPERIMENTAL STUDY OF SOLUTE TRANSPORT IN A STONY FIELD SOIL,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
R. Schulin, M. T. Genuchten, H. Fluhler, and P. Ferlin.
Water Resources Research WRERAQ, Vol. 23, No. 9, p 1785-1794, September 1987. 8 fig, 4 tab, 23 ref.

Descriptors: *Solute transport, *Path of pollutants, *Fate of pollutants, *Soil contamination, *Stony soils, Model studies, Solutes, Pollutants, Tracers, Solute distribution, Groundwater movement, Soil water.

The transport of two conservative tracers, bromide and chloride, was studied in a stony field soil under natural soil, vegetative, and climatic conditions. Small tracer pulses were applied evenly over the 94-sq m plot area in April 1982 (bromide) and October 1982 (chloride). A 15-m-long, 3-m-deep transect through the plot area was extensively sampled in May 1983, approximately 400 days after the bromide and 200 days after the chloride was applied. Tracer concentrations were obtained from 842 samples taken at 61 locations along the transect. Two-dimensional contour plots of the data showed a relatively uniform displacement in the vertical direction, as well as a significant horizontal redistribution during the study period. The data were analyzed with the classical convection-dispersion equation (CDE) and with a regional stochastic model that assumes logarithmic distributions of the pore water velocity and the dispersion coefficient across the field. Both models successfully described momentary field-averaged concentration distributions but failed to predict observed concentration data in October 1984 when another, less intensive sampling was carried out. Pore water velocities could be estimated reasonably well with as few as five vertical sampling lines, whereas dispersion coefficients and solute loads required numerous additional samplings. A field scale dispersivity of about 8 cm was obtained for the CDE model. Between 75 and 130% of the applied tracers were recovered in 1982. The effects of sampling size (0.3 versus 3 kilograms dry soil weight) were found to be relatively small. (Author's abstract)
W88-01919

EPIDEMIOLOGICAL SURVEY OF A MAJOR OUTBREAK OF NOSOCOMIAL LEGIONELLOSIS,
Institut National de la Sante et de la Recherche Medicale, Paris (France).
For primary bibliographic entry see Field 5C.
W88-01920

CHLORINATED HYDROCARBONS IN BIOLOGICAL SEWAGE PURIFICATION - FATE AND DIFFICULTIES IN BALANCING,
Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
For primary bibliographic entry see Field 5D.
W88-01937

FATE OF TOXIC ORGANIC COMPOUNDS IN ACTIVATED SLUDGE AND INTEGRATED PAC SYSTEMS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W88-01941

SIGNIFICANCE OF SEGREGATION OF BIOMASS IN BIOFILMS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
W. Gujer.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 495-503, 1987. 7 fig, 1 tab, 7 ref.

Descriptors: *Biomass, *Biofilms, *Biological water treatment, *Wastewater treatment, *Solute transport, *Model studies, Biomass segregation, Mathematical models, Microorganisms, Mathematical equations, Mathematical studies.

Solute transport within fixed biomass is usually assumed to be due to molecular diffusion and it results in solute concentration gradients even on a microscopic scale. This is in contrast to most suspended growth systems where transport on a microscopic scale is usually orders of magnitude faster than conversion, and therefore such solute gradients do not develop. In modelling biofilms the most frequent approach is: (1) to consider microscopic gradients in one dimension only to describe biofilm behavior, and (2) to use macroscopic gradients along a reactor coordinate to describe system performance. This approach assumes that microscopic solute concentration gradients are negligible perpendicular to the depth coordinate within a biofilm. Therefore, the effect of segregation of different species of particulate material (e.g. microorganisms) on biofilm performance is discussed with the aid of analytical and numerical model predictions. Based on two case studies, it appears that segregation is an important aspect of biofilm behavior and cannot a priori be neglected as is frequently the case in biofilm modeling. In order to improve the reliability of deterministic biofilm models, experiments are required to define the significance of segregation in biofilms. (Wood-PTT)
W88-01943

REDUCTION OF MICROBIAL INDICATORS AND VIRUSES IN A CYPRESS STRAND,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
P. R. Scheuerman, S. R. Farrah, and G. Bitton.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 539-546, 1987. 2 fig, 4 tab, 18 ref. EPA Grant R809402.

Descriptors: *Microbial indicators, *Fate of pollutants, *Path of pollutants, *Wastewater disposal, *Cypress strands, Trees, Microbiological studies, Bacteriophage, Viruses, Enteroviruses, Effluents, Florida, Wetlands, Sediments, Pollutants, Coliforms, Municipal wastewater.

The fate of bacterial indicators, bacteriophages and enteroviruses was studied in a forested cypress strand treated with primary effluent from the town of Waldo, Florida. Experimental corridors (40m x 10m) were installed in a strand and were treated with pumped primary effluent. Bacterial indicators (total and fecal coliforms, fecal streptococci), bacteriophages and enteroviruses, were removed following 40m travel of sewage through the corridors. The results indicated that fecal streptococci accumulate in the sediments. The level of bacterial indicators, phages and enteroviruses were monitored in another strand that had been receiving sewage for 50 years. Microbial numbers were determined at stations situated at increasing distances from the sewage outfall (up to 230m). It was observed that the bacterial indicators were reduced approximately by 3 log base 10 units at the 230m-station. Fecal streptococci were shown to accumulate in the sediments. The reduction in the number of phages was less and was approximately one log base 10 unit. Enteroviruses and Salmonella spp.

were detected in the cypress strand water. They were often undetectable in the sediments. The results demonstrate the potential use of wetlands for low-energy treatment of sewage effluents. (Author's abstract)
W88-01947

SURVIVAL OF INDICATOR ORGANISMS IN A DETENTION POND RECEIVING COMBINED SEWER OVERFLOW,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
L. Lijklema, B. Habekotte, C. Hooijmans, R. H. Aalderink, and A. H. Havelaar.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 547-555, 1987. 7 fig, 4 tab, 9 ref.

Descriptors: *Bacteria, *Bacteriophages, *Fate of pollutants, *Detention ponds, *Wastewater treatment, Combined wastewater, Sediments, Microbiological studies, Survival, Wastewater.

Removal of four groups of indicator bacteria and two groups of bacteriophages in a detention pond receiving Combined Sewer Overflows (CSO) was measured. Also the survival of the bacteria in the sediments was studied. The overall removal rate of the bacteria tended to be somewhat higher than the removal rate for phages. Most values were in the range of 0.7 - 1.0 per day (e-basis). Sedimentation was of limited importance except for a short period following the overflow event. Dilution contributed in a reduction of 0.3 - 0.4 per day and die-off rates were about 0.3 - 0.6 per day; rates for phages could be as low as 0.2 per day. Survival of the bacteria in the sediment was much better than in the water; net loss rates were about 0.1 per day resulting in a more or less continuous contamination of the sediment with pathogenic bacteria as represented by indicator organisms. (Author's abstract)
W88-01948

METHODS OF LIMITING POLLUTANT WASHOUT FROM FARMING AREAS BY NONPOINT AND DRAINAGE FLOWS,
Institut Gidrodinamiki, Novosibirsk (USSR).
For primary bibliographic entry see Field 5G.
W88-01966

LIGNIN GEOCHEMISTRY OF SEDIMENTS FROM THE NARRAGANSETT BAY ESTUARY,
Battelle New England Marine Research Lab., Duxbury, MA.
For primary bibliographic entry see Field 2L.
W88-01970

EMISSION AND IMMISSION OF ORGANIC HALOGEN COMPOUNDS IN THE CATCHMENT AREA OF THE RIVER RUHR (EMISSION UND IMMISSION VON AOX IM RUHREINZUGSGEBIET),
R. Klopp, and K. H. Kornatzki.
Zeitschrift fur Wasser-und Abwasser-Forschung ZWABAQ, Vol. 20, No. 5, p 160-167, October 1987. 10 fig, 1 tab, 25 ref.

Descriptors: *Water pollution sources, *Organic compounds, *Ruhr River, *Hallogenated organic compounds, Halogens, Municipal wastewater, Chemical analysis, Cellulose.

By measuring immission and emission of organic halogens (AOX), the origin and locations of halogenous organic substances were investigated in the catchment area of the River Ruhr. A first balance is given: a fifth of the annual AOX-emission into the receiving waters arises from the municipal clarification plants, a third from direct emitting cellulose works and nearly half from diffuse sources caused by precipitation. The average AOX-concentration in rain is about 20 micrograms/L, which increases in the runoff from unpaved areas and in groundwater runoff which is close to the surface. The AOX-load in runoff from paved areas is nearly as high as in municipal wastewaters. Laboratory experiments showed the formation of halogenous organic substances when HCl gas reacts with unsaturated terpenes from natural spruce oil under exposure to sunlight. This result raises the question whether a considerable part of the AOX in receiving waters is of biogenic origin. (Author's abstract)
W88-01974

DISTRIBUTION AND IN SITU SURVIVAL AND ACTIVITY OF KLEBSIELLA PNEUMONIAE AND ESCHERICHIA COLI IN A TROPICAL RAIN FOREST WATERSHED,
Puerto Rico Univ., Rio Piedras. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W88-01986

TEMPORAL VARIATION OF METALS IN THE SEAGRASS POSIDONIA AUSTRALIS AND ITS POTENTIAL AS A SENTINEL ACCUMULATOR NEAR A LEAD SMELTER,
Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Marine Labs.
T. J. Ward.
Marine Biology MB10AJ, Vol. 95, No. 2, p 315-321, July 1987. 1 fig, 4 tab, 34 ref.

Descriptors: *Heavy metals, *Seagrass, *Bioaccumulation, *Bioindicators, Cadmium, Copper, Manganese, Nickel, Lead, Zinc, Marine environment, Temporal distribution, Leaves.

Temporal variation in the concentrations of Cd, Cu, Mn, Ni, Pb and Zn in leaves of the seagrass Posidonia australis was studied at three sites near a lead smelter on the shore of Spencer Gulf, a large hypersaline marine embayment in South Australia, on four occasions from October 1980 to September 1981. Concentrations of Cd, Mn, Pb and Zn of up to 541, 537, 379 and 4,241 micrograms/gm, respectively, were found in leaves collected from the site nearest to the smelter. A substantial temporal variation in the concentrations of these metals in samples from all sites resulted from the combined effect of leaf age and collection strategy. Concentrations of Cd, Cu and Zn in the leaf epibiota were lower than those in the leaves, but the reverse was true for Mn and Ni. The use of seagrass leaves as sentinel accumulators for Cd, Pb and Zn must be based on collections made at the same time of year, or otherwise account for the effect of leaf age on concentrations of the metals in the samples. (Author's abstract)
W88-01997

ACIDIC DEPOSITION TO FORESTS: THE 1985 CHEMISTRY OF HIGH ELEVATION FOG (CHEF) PROJECT,
Atmospheric Environment Service, Downsview (Ontario).
R. S. Schemenauer.
Atmosphere-Ocean ATOCDA, Vol. 24, No. 4, p 303-328, December 1986. 12 fig, 6 tab, 70 ref.

Descriptors: *Acid rain, *Rainfall, *Precipitation, *Forests, Hydrogen ion concentration, Water analysis, Deposition, Fog, Clouds.

The literature supporting significant water deposition directly from cloud and fog to the earth's surface is reviewed and previous aircraft and surface measurements of the acidity of this water are summarized. An overview of recent work on forest decline is given and an American (Mountain Cloud Chemistry Project) and Canadian (Chemistry of High Elevation Fog) program to look at the chemical deposition by clouds to high elevation forests is described. Preliminary measurements in late 1985 on two mountains in Quebec indicate that fog (cloud on the mountain) water pH values (= 3.8) near the summits (850-970 m) are much lower than precipitation pH values (= 4.3) at the same location; the summits are estimated to be in cloud 44% of the year with lower percentages at lower elevations; an estimate of total annual fog water deposition (77 cm) near the summit is similar to the average annual precipitation in Quebec; the estimated fog water hydrogen ion deposition (135 meq/sq m) is about three times that from the precipitation; the precipitation pH values may be lower (4.1 versus 4.3) at lower elevations with precipitation amounts perhaps 50% higher at higher elevations. (Author's abstract)
W88-02003

MEASUREMENT OF CADMIUM ADSORPTION ON SEDIMENTS OF LAKE COMABBIO - NORTH ITALY (MESURES D'ADSORPTION DU CADMIUM SUR LES SEDIMENTS DU LAC DE COMABBIO - ITALIE DU NORD),
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
Y. Libert.
Environmental Technology Letters ETLEDB, Vol. 8, No. 4, p 189-196, April 1987. 1 fig, 2 tab, 15 ref.

Descriptors: *Path of pollutants, *Adsorption, *Water chemistry, *Lake sediments, *Lakes, *Limnology, *Cadmium, Regression analysis, Heavy metals, Italy, Sediments.

A multiple linear regression analysis of results of adsorption tests on lake sediments, so conducted as to reach a cadmium content of these equivalent to a maximum of 5% of their surface area, revealed a linear relationship between cadmium contents of the sediments and initial concentration of water phase. Adsorption kinetics are fast (content of cadmium at 1 min. = 0.7 content at 1000 min.). Solid phase/liquid phase partition depends on sediments concentration, however, it does not depend on the total surface area. An equation for the adsorption isotherm has been established. (Author's abstract)
W88-02016

ADSORPTION OF COPPER, ZINC AND LEAD BY BED SEDIMENTS OF RIVER GANGES IN INDIA,
Roorkee Univ. (India). Dept. of Civil Engineering.
D. K. Saikia, R. P. Mathur, and S. K. Srivastava.
Environmental Technology Letters ETLEDB, Vol. 8, No. 3, p 149-152, March 1987. 3 fig, 1 tab, 3 ref.

Descriptors: *Path of pollutants, *Adsorption, *River sediments, *Heavy metals, Ganges River, Sediments, Ions, Copper, Zinc, Lead, India.

The adsorption of Cu(2+), Zn(2+) and Pb(2+) from aqueous solution by bed sediment of the river Ganges, India, was studied. The parameters controlling the adsorption viz. the solution pH, contact time, sediment dose and the effect of competing ions were studied in detail. The solution pH was found to be the most influential parameter. The presence of Cu(2+) and Zn(2+) hinders the uptake of Pb(2+), so is the case with Zn(2+) in presence of Cu(2+) and Pb(2+). But the presence of Zn(2+) and Pb(2+) enhanced the uptake of Cu(2+). (Author's abstract)
W88-02021

AEOLIAN CONTRIBUTIONS OF TRACE METALS TO MARINE SEDIMENTS OF KUWAIT,
Kuwait Inst. for Scientific Research, Safat. Environmental and Earth Sciences Div.
O. Samhan, M. Zarba, and V. Anderlini.
Environment International, Vol. 12, No. 6, p 611-617, 1986. 3 fig, 3 tab, 33 ref.

Descriptors: *Path of pollutants, *Marine sediments, *Kuwait, *Trace elements, *Heavy metals, Sediments, Metals, Water pollution sources, Fallout, Dust.

Concentrations of silver, cadmium, chromium, iron, manganese, nickel, lead, vanadium, and zinc were determined in dust fallout samples from eight inland locations in Kuwait. Results were used to calculate enrichment factors for metals relative to their abundance in the continental crust using Fe as the conservative element. Five metals (Cu, Cr, Mn, Ni, and V) showed enrichment factors that were approximately unity (1.3-4.7). Higher enrichment factors for the rest (24-421) suggested an anthropogenic contribution for Ag, Cd, Pb, and Zn. However, all metals in dust fallout (except Pb and Zn) showed a degree of enrichment relative to unpolluted marine sediments that was approximately unity, suggesting a substantial aeolian contribution to trace metals in marine surface sediments. Higher enrichments for Pb and Zn probably reflect a larger input from local pollution sources. This is

particularly true for lead, the enrichment of which showed a stronger association with the distribution of urban population. Probable contributions of aeolian transport to a band of elevated lead concentrations in marine surface sediments are discussed. (Author's abstract)
W88-02024

EFFECTS OF FEEDING AND TEMPERATURE ON UPTAKE, ELIMINATION AND METABOLISM OF BENZO(A)PYRENE IN THE BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS),
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 5C.
W88-02027

BIOTRANSFORMATION OF MOLINATE (ORDRAM) IN THE STRIPED BASS (MORONE SAXATILIS),
California Univ., Davis. Dept. of Environmental Toxicology.
R. S. Tjeerdema, and D. G. Crosby.
Aquatic Toxicology AQTODG, Vol. 9, No. 6, p 305-317, February 1987. 5 fig, 3 tab, 35 ref. Toxic Substance Control Board Contract 2-125-428-1 and NIEHS Training Grant ES 07059.

Descriptors: *Bass, *Path of pollutants, *Fate of pollutants, *Molinate, *Bioaccumulation, *Isotope studies, Metabolism, Excretion, Fish, Toxicity.

Bioconcentration, depuration, and biotransformation of molinate in striped bass (Morone saxatilis) were studied in a flow-through metabolism system. When compared to static conditions, flowing water improved oxygenation, decreased volatilization and remetabolism and, run through a macroreticular resin, improved waste-product collection. Metabolite identification and quantitation employed high-pressure liquid chromatography; gradient elution optimized peak resolution and minimized analysis time. Exposure of juvenile fish to 100 microgram(ug)/L (ring-14C)molinate for 24 h resulted in a bioconcentration factor of 25.3 and a 14C total concentration factor of 30.9 (in molinate molar equivalents). After 24-h depuration, 90.47% of the absorbed 14C had been excreted; metabolites accounted for 19.20% of the depurated and 7.92% of the retained 14C. The identified metabolites included molinate sulfoxide, carboxymolinate, 4-hydroxymolinate, molinate mercapturic acid, 4-ketomolinate, and hexahydroazepine. While molinate is highly toxic to Japanese carp (Cyprinus carpio var. Yamato Koi), sulfoxidation, followed by glutathione conjugation and/or rapid depuration, may effectively reduce the toxicity of molinate to striped bass. (Author's abstract)
W88-02029

ANALYSIS OF ADDUCT FORMATION IN THE BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS) BETWEEN BENZO(A)PYRENE AND DNA OF THE LIVER AND HEMOGLOBIN OF THE ERYTHROCYTE,
Oak Ridge National Lab., TN. Engineering Technology Div.
For primary bibliographic entry see Field 5C.
W88-02030

TRACING OF XENOBIOTIC CONTAMINATION IN WATER WITH THE AID OF FISH BILE METABOLITES: A FIELD STUDY WITH CAGED RAINBOW TROUT (SALMO GAIRDNERI),
Joensuu Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W88-02031

INCREASED HEPATIC METALLOTHIONEIN CONTENT CORRELATES TO CADMIUM ACCUMULATION IN ENVIRONMENTALLY EXPOSED PERCH (PERCA FLUVIATILIS),
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
P.-E. Olsson, and C. Haux.
Aquatic Toxicology AQTODG, Vol. 9, No. 4,5, p 231-242, December 1986. 4 fig, 3 tab, 31 ref.

Descriptors: *Water pollution effects, *Cadmium, *Path of pollutants, *Perch, *Metallothionein, Heavy metals, Sweden, Tissue analysis, Fish, Rivers, Liver.

The subcellular distribution of cadmium, copper and zinc in the liver, and the binding of these heavy metals to metallothionein (MT) were studied in a wild population of perch (Perca fluviatilis). The fish were caught in two areas of the cadmium-contaminated river Eman in the southeast of Sweden. The livers were analyzed for zinc, copper and cadmium and the subcellular distribution of the heavy metals in mitochondrial, microsomal and cytosolic fractions was determined. The cytosols were chromatographed on Sephadex G-75 columns to determine the partition of heavy metals between high molecular weight and MT fractions. Metallothionein was determined, in tissue extracts, by differential pulse polarography. The elevated hepatic cadmium levels found in perch from the contaminated region of the river did not significantly alter the distribution of zinc and copper in the liver. With increasing amounts of cadmium present in the liver cytosol, the distribution of cadmium was altered. The increased cadmium content correlated with an increased MT level in the liver ($r = 0.84$). The relationship between cadmium and MT is described by the formula (MT) = 7.2 + 0.53 (Cd). Chromatography of the liver revealed that all of the applied cadmium was bound to MT. The variations in zinc and copper showed low correlation to the MT content of the liver ($r = 0.51$ and $r = -0.15$, respectively). (Author's abstract)
W88-02035

COMPARATIVE TOXICITY, CHOLINERGIC EFFECTS, AND TISSUE LEVELS OF S,S,S,-TRI-N-BUTYL PHOSPHOROTRITHIOATE (DEF) TO CHANNEL CATFISH (ICTALURUS PUNCTATUS) AND BLUE CRABS (CALLINECTES SAPIDUS),
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5C.
W88-02040

NITROGEN AND WATER BALANCE STUDIES IN RELATION TO FARMYARD MANURE AND N-FERTILIZER APPLICATIONS TO SRI LANKAN LUVISOLS,
Sri Lanka Univ., Peradeniya. Postgraduate Inst. of Agriculture.
D. M. Jinadasa, B. W. Eavis, F. R. Bolton, and M. W. Thenabadu.
Tropical Agriculture TAGLA2, Vol. 64, No. 1, p 49-54, January 1987. 6 fig, 3 tab, 9 ref.

Descriptors: *Path of pollutants, *Drainage, *Nitrogen cycle, *Hydrologic budget, *Farm wastes, *Manure, *Fertilizers, *Sri Lanka, *Soil types, *Groundwater pollution, Nitrates, Moisture meters, Lysimeters, Domestic water, Irrigation, Sulfates, Ammonia, Nitrogen, Leaching, Capsicum.

Dangerously high nitrate concentrations in groundwater used for domestic purposes prompted field and lysimeter studies which highlight the importance of minimizing drainage and N-fertilizer applications in intensively irrigated areas. Seventy-six g N (field) and 60 g N (lysimeter)/ha were leached per mm of drainage on plots receiving 120 kg fertilizer-N/ha, as ammonium sulfate. Within the range of 0-120 kg fertilizer-N/ha, the total N/ha leached was 2-10 kg (field) and 2-28 kg (lysimeter), with 110 and 465 mm drainage over 81 and 56 days. Three times (field) and ten times (lysimeter) more N was leached as nitrate than as ammonium; total N losses were similar from ammonium sulfate and urea. The amount of N leached increased by 160% from a 3-fold increase in N-fertilizer rate. A crop of chillies removed the equivalent of 47 and 67% of the fertilizer N; yields of dry chillies increased from 300 to 700 kg/ha in response to 0-120 kg fertilizer-N. There was no yield response to farmyard manure at 12.5 t/ha (100 kg N/ha), even in the absence of fertilizer. N leached from farmyard manure plots was much less than from plots receiving 40-120 kg fertilizer-N/ha. (Author's abstract)
W88-02081

SEDIMENT QUALITY CRITERIA - GENERAL ASPECTS AND INTERNATIONAL STATE OF DISCUSSION (QUALITAETSKRITERIEN FUER GEWAESSERSEDIMENTE - ALLGEMEINE PROBLEMATIK UND INTERNATIONALER STAND DER DISKUSSION),
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
For primary bibliographic entry see Field 5A.
W88-02086

INFLUENCE OF OXYGEN ON THE DIRECT PHOTOLYSIS OF SIMPLE AROMATICS IN AQUEOUS SYSTEMS (EINFLUSS VON SAUERSTOFF AUF DIE DIREKTPHOTOLYSE EINFACHER AROMATEN IN WAESSRIGEN SYSTEMEN),
Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Oekologische Chemie.
P. N. Moza, and H. Parlar.
Naturwissenschaften NATWAY, Vol. 74, No. 3, p 137-138, March 1987. 1 tab, 4 ref.

Descriptors: *Fate of pollutants, *Oxygen, *Aromatic hydrocarbons, *Ultraviolet radiation, Oxidation, Solar radiation, Surface water, Water treatment, Hydrocarbons.

The long-wave UV absorption bands of simple aromatics (benzene, toiuene, xylene, cumene) exceed 290 nm in an oxygen-partial-pressure dependent manner. Light initiated excitation of these substances can be initiated under normal circumstances, contrary to commonly accepted perceptions. When the test solutions are bubbled with an inert gas (argon nitrogen) the effect spontaneously disappears. Products include the corresponding phenols, benzoic acids, ketones and aldehydes. A discussion of possible mechanisms is included. (Airone-PTT)
W88-02101

239, 240PU LEVELS IN MUSSELS MYTILUS SP. COLLECTED FROM THE FRENCH COASTS (1983-1984): A RADIOCHEMICAL AND MICROANALYTICAL STUDY (SUIVI DES NIVEAUX DE PLUTONIUM 239-240 DANS DES MOULES MYTILUS SP. PREVELEES SUR LE LITTORAL FRANCAIS (1983-1984): ETUDES RADIOCHIMIQUE ET MICROANALYTIQUE),
CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses (France).
D. Calmet, S. Charmasson, J. M. Willemot, M. Verry, and C. Chassard-Bouchaud.
Comptes Rendus de l'Academie des Sciences (Series 3) CHDDAT, Vol. 304, No. 9, p 199-206, March 1987. 1 fig, 3 tab, 34 ref.

Descriptors: *Plutonium, *Path of pollutants, *Water pollution effects, *Mytilus, *Nuclear powerplants, *Fallout, *Bioindicators, Radiochemical analysis, Radioactive wastes, Mass spectrometry, Nuclear explosions, Heavy metals.

Plutonium concentration in Mytilus sp. samples collected from the French coast, Atlantic Ocean, Channel, and Mediterranean Sea was investigated by two procedures: a radiochemical method in order to determine the radioactivity in the whole body and a microanalytical method, secondary ion mass spectrometry, allowing detection and imaging of plutonium distribution at the cellular level. Plutonium concentration was highest in the digestive gland of the mussel which appears to be a bioindicator of radionuclide contamination. The differences observed between the collection sites during the two years of sampling make it possible to distinguish between areas under the influence of fallout from nuclear weapons tests and areas contaminated by radioactive wastes from nuclear plants. The health consequences of plutonium ingestion appear negligible in all cases. (Author's abstract)
W88-02105

EVALUATION OF THE REPARTITION OF PCBS BETWEEN DISSOLVED AND PARTICULATE MATTER IN RIVER SEINE (FRANCE) (EVALUATION DE LA REPARTITION PARTICULAIRE/AQUEUSE DES PCB (POLYCHLOROBIPHENYLES) EN SEINE),
Paris-6 Univ. (France). Inst. d'Hydrologie et de Climatologie.
M. Chevreuil, A. Chesterikoff, and R. Letolle.
Comptes Rendus de l'Academie des Sciences (Series 2) CHDCAQ, Vol. 304, No. 9, p 425-430, March 1987. 4 fig, 8 ref.

Descriptors: *Polychlorinated biphenyls, *Path of pollutants, *Dissolved solids, *Suspended solids, Particulate matter, Drinking water, Pesticides, Adsorption, Seasonal variations, Chlorinated hydrocarbons, Solubility, Seine River.

Pollution and transfer characteristics of PCBs have been studied from January to September 1986 on the course of the Seine near drinking water production plants. In all, 42 samples were obtained. PCB content varied irregularly from 20 to nearly 1000 ng/l. This pollution is more important than that induced by other chlorinated pesticide compounds. Transfer is mostly under the dissolved form in opposition to current ideas based on the low solubility of PCBs. This results from the inverse relationship between growth of the solid suspension content and its adsorption capacity. This may be prejudicial to the drinking water quality during low water mark seasons. (Airone-PTT)
W88-02106

UPTAKE OF CADMIUM AND ZINC BY CORN ON SLUDGE-TREATED SOILS,
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 5E.
W88-02124

WASTES FROM PROCESSING OF PHOSPHATE INDUSTRY,
Yarmouk Univ., Irbid (Jordan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W88-02143

SORPTION/DESORPTION OF VARIOUS INORGANIC AGENTS ON OIL SHALE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W88-02154

INFLUENCE OF INDUSTRIAL WASTES ON THE FORMATION OF VOLATILE HALOGENATED ORGANICS DURING EFFLUENT CHLORINATION,
Cook Coll., New Brunswick, NJ.
For primary bibliographic entry see Field 5D.
W88-02195

TRANSPORT OF ENERGY-RELATED ORGANIC COMPOUNDS AND MIXTURES IN SUBSURFACE ENVIRONMENTS,
Battelle Pacific Northwest Labs., Richland, WA.
D. C. Girvin, J. M. Zachara, C. T. Kincaid, and F. J. Wobber.
Subsurface Transport Program, Research Plan. Report No. DOE/ER-0229, November 1984. 40 p, 2 fig, 4 tab, 53 ref.

Descriptors: *Groundwater pollution, *Path of pollutants, *Organic compounds, *Subsurface environment, *Research priorities, Microbiological studies, Chemical analysis, Hydrologic properties, Model studies, Amines, Aromatic compounds, Phenols, Nitroaromatics, Thioamines, Hydrocarbons, Furans.

The Department of Energy (DOE) Office of Health and Environmental Research within the Office of Energy Research (OER) is planning a 10-year program of fundamental research dealing with the transport of energy-related organic chemicals and complex mixtures in subsurface environments. This research initiative focuses on the following: (1) developing an improved understanding of microbiological, chemical, and hydrologic processes which influence the transport of organic compounds and mixtures in subsurface porous media; and (2) incorporating this knowledge into predictive hydrologic and transport models which reliably describe the movement, persistence, and biological availability of organic compounds and mixtures. Utilization of predictive transport models, which include microbiological and chemical interactions, will require the advanced computational power of CRAY (or equivalent) computer systems. The program requires laboratory and field-oriented research to elucidate basic processes controlling organic contaminant movement and fate in subsurface environments. The laboratory and field experimentation will proceed concurrently, thus yielding a balanced understanding of microbiological, chemical, and hydrologic processes on the field scale. Important compound classes, organic solvents, and complex organic mixtures found in, or derived from, energy/defense wastes are included in the research program. Organic compound classes (Amines, Basic aromatic N-Heterocycles,a Phenols, Neutral Aromatic N-Heterocycles, Nitroaromatics, Thiophenes, Neutral Aromatic Hydrocarbons, Furans) have been preliminarily selected for detailed study. These compounds (1) are relevant to the energy technologies; (2) typically exhibit mobility and persistence in the subsurface; and (3) are potentially toxic to ecosystems and to humans. Another important and unique aspect of the research is the proposed use of highly instrumented field-scale facilities as an intermediate stage between laboratory and field experimentation. (Lantz-PTT)
W88-02263

SUBSURFACE FLOW AND TRANSPORT OF ORGANIC CHEMICALS: AN ASSESSMENT OF CURRENT MODELING CAPABILITY AND PRIORITY DIRECTIONS FOR FUTURE RESEARCH (1987-1995),
Battelle Pacific Northwest Labs., Richland, WA.
G. P. Streile, and C. S. Simmons.
Subsurface Transport Program, Research Highlights. Report No. DOE/ER-0307, September 1986. 74 p, 1 fig, 147 ref, append. DOE Contract No. DE-AC06-76RLO 1830.

Descriptors: *Groundwater pollution, *Path of pollutants, *Organic compounds, *Model studies, *Research priorities, *Subsurface flow, Landfills, Groundwater pollution, Geochemistry, Microbiological studies, Computer models, Theoretical analysis, Solute transport.

Waste organic chemicals have been disposed of in DOE landfill sites and as ancillary components in DOE low-level radioactive waste burial operations. Groundwater supplies on DOE lands are increasingly found to be contaminated with organic substances; and, as energy development and national defense activities grow, the need to understand and to mitigate such organic chemical contamination are increasing sharply. Fundamental scientific understanding of the hydrophysics, geochemsitry, and microbiology affecting the transport of organic chemical mixtures must be improved if the Nation is to develop effective methods for remediation. This report takes a forward look toward what modeling needs and what scientific steps are likely to be important in achieving the goal of a new generation of predictive models. The report examines current theoretical and computer modeling capabilities for assessing the subsurface movement of organic contaminants and specifically the entry of energy-related, organic compounds into the subsurface environment as components of a liquid phase separate from groundwater. The subsurface transport of organic chemical solutes is certainly within DOE's research interests; however, modeling the transport of chemicals in aqueous solution has already been the subject of several reviews. Hence, analysis of a multiphase transport scenario is emphasized. (Lantz-PTT)
W88-02264

PROCEEDINGS, SECOND INVESTIGATORS' MEETING - SAVANNAH RIVER EXPLORATORY DEEP PROBE.
September 23-23, 1986. Microbiology of Subsurface Environments. Report No. DOE/ER-0312, (1986). 14 p, 2 fig, 2 append.

Descriptors: *Information exchange, *Savannah River, *Microbiological studies, *Subsurface environment, *Microorganisms, *Fate of pollutants, *Groundwater pollution, *Path of pollutants, Methane bacteria, Fungi, Protozoa, Aerobic zone, Sulfur bacteria.

The major scientific goals of DOE's program in Deep Subsurface Microbiology are to investigate: (1) the presence, abundance, and diversity of microorganisms in the deep subsurface; (2) the factors controlling microbial presence and activity; (3) the capabilities and functions of indigenous microorganisms and communities (e.g. metabolic activities and rates, biotransformation processes, growth rates, unique capabilities); (4) differences between deep and near surface microbiota; and (5) implications for mitigating contamination through stimulation of the indigenous microorganisms or introduction of bioengineered strains and the potential environmental impact of these manipulations on subsurface ecosystems. The initial effort of this program focused on scientific investigations to define microbiological life in the deep subsurface below the Savannah River Plant in South Carolina. The preliminary scientific results indicate that a diverse, metabolically active microbial community is present in unconsolidated materials to depths of 400 meters below the surface of the Savannah River study site. For the first time a thorough characterization of samples by collaborating university and national laboratory scientists has revealed that deep subsurface environments are inhabited by microorganisms that range from denitrifying, sulfate-reducing, and methanogenic bacteria to aerobic heterotrophs, autotrophs, fungi, and protozoa. These results have implications in the use of indigenous microorganisms for biological decontamination of deep aquifers or as a biobarrier to contaminant movement, development of strategies to cope with health problems arising from contamination of aquifers by pathogenic microorganisms, reduction of biocorrosion of waste containers planned for storage in deep subsurface environments, and as a source of new organisms or metabolic capabilities for biotechnological applications. (Lantz-PTT)
W88-02265

HYDROSPHERIC TRACE ELEMENTS AND THEIR APPLICATION IN TRACING WATER POLLUTANTS,
Oregon State Univ., Corvallis. Dept. of Chemistry.
W. D. Loveland.
Available from the National Technical Institute Service Springfield, VA 22161, as PB87-202180. Price code A03 in paper copy, A01 in microfiche. Technical Completion Report, June 1983. 109 p, 13 ref, 13 append. Department of the Interior Contract No. 14-34-0001-8110, and Project No. B-055-ORE(1).

Descriptors: *Path of pollutants, *Fate of pollutants, *Trace elements, *Tracers, Radioactive tracers, Rare earth elements, Organic compounds, Estuaries, Sodium chloride, Potassium, Sulfates, Carbonates, Tritium, Plutonium, Bromine, Rhodamine.

Stable activable tracer technologies employing rare earth nuclides with short-lived activation products have been developed and tested in both the laboratory and field. Applications of these tracers to monitor pollutant dispersal in fresh water and estuarine systems and to trace toxic organic chemicals in the marine environment are described. The development, testing and application of stable x-ray fluorescent tracers for small water systems is also described. These tracers include: (1) chemical tracers, such as NaCl, KHSO4, and K2CO3; (2) radioactive tracers, such as 3-H, 32-P, and 82-Br; and (3) fluorescent dyes, such as fluorescein, Rhodamine B, and Rhodamine WT. The rare earth elemental concentrations in Pacific Northwest rivers have been studied experimentally and theo-

retically, leading to conclusions about controlling factors for rare earth concentrations in rivers and the global rare earth hydrospheric material balance. (See W88-03262)(Lantz-PTT)
W88-02271

PREDICTION OF SURFACE RUNOFF WATER QUALITY FROM BLACK ROCK HARBOR DREDGED MATERIAL PLACED IN AN UPLAND DISPOSAL SITE,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5E.
W88-02279

MERCURY IN THE ECOSYSTEM: ITS DISPERSION AND POLLUTION TODAY,
Jadavpur Univ. (India). Dept. of Geology.
S. Mitra.
Trans Tech Publications Ltd. (Switzerland). 1986. 327 p.

Descriptors: *Mercury, *Path of pollutants, *Water pollution effects, Fate of pollutants, Ecosystems, Industrial wastes, Organic matter, Environmental effects, Methylmercury.

Mercury is widely distributed in the geological environment. The use of mercury in various industries, and also the accumulation of mercury in the animal and plant kingdoms due to the increasing discharge of mercury into the ecosystem as various types of industrial effluent, are documented in this monograph. Various analytical methods for estimating the content of mercury in organic and inorganic matter are described, and these should be of help in selecting the proper techniques to be used for the estimation of the concentration of this toxic metal. The effects of environmental pollution by this metal upon the human population are discussed, and the symptoms of, and remedies for, mercury poisoning are described. Recent concepts regarding the mechanism of methylmercury formation in contaminated matter and possible mechanisms for its effect at the chromosome level are also discussed. (Lantz-PTT)
W88-02323

TWO-EQUATION MODEL FOR CONTAMINANT DISPERSION IN NATURAL STREAMS,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
R. Smith.
Journal of Fluid Mechanics JFLSA7, Vol. 178, p 257-277, May 1987. 14 fig, 11 ref.

Descriptors: *Model studies, *Path of pollutants, *Rivers, *Streams, *Dispersion, Pollutants, Mathematical equations, Streamflow.

A simple two-equation model was derived so that the total contaminant exposure, the mean time of arrival, the temporal spread, and the skewness, are asymptotically correct at large distances downstream of a discharge. The role of changes in the breadth of a river upon the dispersion process was investigated by a means of an illustrative example. This reveals cubic dependence upon the breadth, and hence the great importance of wide reaches of rivers as regards contaminant dispersion. (Author's abstract)
W88-02328

REGIONAL HYDROGEOLOGIC RESEARCH IN THE PALO DURO BASIN FOR NUCLEAR-WASTE REPOSITORY SITING,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 5E.
W88-02331

TRACE METAL DISTRIBUTION IN DROWNED PLANTS, SHASTA RESERVOIR, CALIFORNIA,
Bureau of Reclamation, Sacramento, CA. Mid-Pacific Regional Office.
N. P. Prokopovich.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 24, No. 2, p 259-266, May 1987. 5 fig, 1 tab, 9 ref.

Descriptors: *Trace metals, *Path of pollutants, *Reservoirs, *Plants, *Heavy metals, Tissue analysis, Runoff, Sulfides, Mining, Roots, Distribution.

Long-term pollution impact of runoff from old sulfide mines into Shasta Reservoir was qualitatively investigated by determination of content of Cu, Zn, Pb, and Cd in 3-normal hydrochloric acid extracts of rooted plant remnants flooded by the reservoir and of driftwood. Ashes of plant tissues, rather than wood scrapings, were used for extraction. Values obtained were recalculated to show the metal content in wood. Altogether, 12 wood samples of rooted plants, 9 samples of driftwood, 4 samples of topsoil and growing plants, and 8 samples of reservoir water were collected at 12 sites in November 1981 and July 1982. In water samples all four trace metals were either absent or present below their detection limits. With the exception of three samples, in which lead was either absent or present below the detection limit, all trace metals were detected in ashes of all plant tissues. The metal content of driftwood was consistently lower than the metal content of dead rooted plants. There also was notable increase of concentration of trace metals in rooted plant remnants collected in reservoir arms located near old mines. A similar approach may be suggested for a reconnaissance study of the distribution of pollution in other water bodies. (Author's abstract)
W88-02333

EFFECT OF HYDROLOGICAL FACTORS ON TRACE METAL CONTAMINATION IN THE RIVER TAWE, SOUTH WALES,
University Coll. of Swansea (Wales). Dept. of Geography.
S. C. Bird.
Environmental Pollution, Vol. 45, No. 2, p 87-124, 1987. 7 fig, 5 tab, 66 ref.

Descriptors: *Path of pollutants, *Rivers, *Trace metals, *River Tawe, *Heavy metals, Distribution, Weathering, Erosion, Flow, Runoff, Hydrology, Water pollution sources.

The concentrations of nickel, copper, iron, chromium, lead, cadmium, manganese and zinc have been studied in a small river in South Wales. The river drains the contaminated industrial wasteland of the Lower Swansea Valley which is currently undergoing redevelopment and landscaping activity. The high trace metal levels found in the river waters result from weathering and erosion of this waste material, as well as from two industrial point sources of nickel, and iron and chromium. Hydrological factors found to be of importance in determining current spatial and temporal patterns of contamination included: (1) the river's available dilution at any one time, (2) antecedent river flow conditions, (3) river water pH and (4) the prevailing runoff processes in operation at any one time. The metals are present mostly in their dissolved state (i.e. > 70%), with the exception of iron and chromium which are present mostly as particulates (i.e. > 80%). (Author's abstract)
W88-02334

UPTAKE OF KEPONE BY THE ESTUARINE BIVALVE RANGIA CUNEATA, DURING THE DREDGING OF CONTAMINATED SEDIMENTS IN THE JAMES RIVER, VIRGINIA,
Virginia State Water Control Board, Richmond.
C. A. Lunsford, M. P. Weinstein, and L. Scott.
Water Research WATRAG, Vol. 21, No. 4, p 411-416, April 1987. 2 fig, 1 tab, 15 ref.

Descriptors: *Estuaries, *Path of pollutants, *Bioaccumulation, *Clams, *Kepone, *Sediments, *Dredging, *James River, Tissue analysis, Pesticides, Virginia.

The uptake of the pesticide Kepone was monitored in situ in the wedge clam, Rangia cuneata, during the dredging of Kepone-contaminated sediments in the James River estuary, Va. After 2 weeks of dredging, residue levels in Rangia at sites along the disposal area were significantly elevated above background; however, Kepone levels in clams at sites downstream of the dredging were not elevated. The increase in tissue contamination (0.01-0.04 microgram/g, mean values) was persistent 2 weeks after dredging was completed. The ecological significance of the Kepone uptake documented during dredging is discussed in relation to the overall Kepone contamination in the James River ecosystem. (Author's abstract)
W88-02339

EFFECT OF ASH DISPOSAL PONDS ON GROUNDWATER QUALITY AT A COAL-FIRED POWER PLANT,
Wisconsin Univ.-Madison. Water Resources Center.
For primary bibliographic entry see Field 5E.
W88-02340

PCB POLLUTION BEHAVIOUR IN THE RIVER SEINE,
Paris-6 Univ. (France). Inst. d'Hydrologie et de Climatologie.
M. Chevreuil, A. Chesterikoff, and R. Letolle.
Water Research WATRAG, Vol. 21, No. 4, p 427-434, April 1987. 7 fig, 2 tab, 15 ref.

Descriptors: *Path of pollutants, *Polychlorinated biphenyls, *River Seine, *Rivers, Flow, Sediments, Pollutants, Hydrology, Organic carbon, Adsorption, Transport.

The contamination of the River Seine (France) and its main tributaries (Yonne, Marne, Oise) have been studied, under different hydrological conditions, at the end of spring before the low watermark and at the beginning of autumn after the first swelling flow. The sector under study consists of the Seine basin, centered on the Paris area; the variability of PCB concentration in water, apart form flow dependence, shows that important lateral discharges are involved. The pollution level is particularly noticeable at Paris and downstream from Paris and the median concentration in sediments reaches 3800 ng/L (ppb). Data on particulate organic carbon and various grain size fractions show the PCB to be preferentially adsorbed on organic-rich sedimentary particles. Partition coefficients between particulate matter and liquid phase have been computed and show that the liquid phase has the main role in micropollutant transport. (Author's abstract)
W88-02341

STUDY BY EPIFLUORESCENCE OF THE FATE OF THE TOTAL BACTERIAL FLORA IN A BOTTLED MINERAL WATER (ETUDE PAR EPIFLUORESCENCE DE L'EVOLUTION DE LA MICROFLORE TOTALE DANS UNE EAU MINERALE EMBOUTEILLEE),
Institut Pasteur de Lille, Villeneuve d'Ascq (France). Service des Eaux.
C. Oger, J. F. Hernandez, J. M. Delattre, A. H. Delabroise, and S. Krupsky.
Water Research WATRAG, Vol. 21, No. 4, p 469-474, April 1987. 1 fig, 2 tab, 20 ref.

Descriptors: *Analytical methods, *Fate of pollutants, *Bacteria, *Bottled water, *Epifluorescence, *Mineral water, Cultures, Microbiological studies, Drinking water.

The microflora of a mineral water (Vittel Grande Source) has been studied after 0, 1, 3, 6 and 12 weeks storage in five kinds of bottles with the Grande Source water itself. The numbers of total bacteria were determined by an automated epifluorescence microscopic technique, the numbers of INT + bacteria and the numbers of colony forming units in nutrient agar, incubated at 30 C for 48 h. Of the bacteria isolated, 1754 strains were identified by classical procedures, and with API 20 NE strips for the Gram-negative rods. Immediately after bottling, an unexpectedly high number of bacteria was found (approx. 100/m/), most of which were minute and gave a weak green fluorescence after acridine staining. Thus a high sensitivity (Norticon) video tube had to be used for enumeration by the image analyzing system. These

minibacteria were probably dormant, and few (< 0.01) were viable on agar. Whatever the type of bottle, multiplication started early and reached approx. 200,000/ml by the 7th day, according to a typical saturation kinetics. In contrast to this, the colony forming ability was achieved later, and the transformation velocity depended on the type of sample: it was rapid in the PVC or of laboratory cleaned glass filled at the spring. The numbers of respiring (INT +) cells were not recorded at zero time (t sub 0) but were found to remain constant or slowly decline from the 7th day to the 12th week. They were sometimes equalled but never exceeded by the numbers of viable bacteria. The species composition of the microflora at t sub 0 could not be determined precisely because of its scarcity. Afterwards, the viable microflora consisted for the most part (> 80%) of five species. (Alexander-PTT)
W88-02346

PILOT STUDY OF SMALL-SCALE MONITORING METHODS OF HERBICIDE RESIDUES IN SOIL AND WATER,
Maine Dept. of Transportation, Bangor. Materials and Research Div.
M. T. Hsu.
Transportation Research Record TRREDM, No. 1075, p 44-48, 1986. 1 fig, 5 tab, 9 ref.

Descriptors: *Path of pollutants, *Herbicides, *Monitoring, Streams, Water analysis, Soil analysis, Chromatography, Extraction, Sample preparation.

Because of its concern for the environmental impact of roadside herbicide spraying, the Maine Department of Transportation initiated a preliminary study of small-scale monitoring methods of herbicide residues in soil and water. Samples were collected at certain time intervals after the application of herbicides to target plants. The herbicides were extracted in the department's Materials and Research Division chemistry lab, and the amount of the extracted herbicides was determined by high-performance liquid chromatograph (HPLC) in the Department of Food Science and Technology at the University of Maine, Orono. The phytotoxicity of Banvel 720 on brush was evident. One week after application, the plants started to show the effect of the herbicide, and by one month, all the foliage showed no signs of life. Herbicide residue was not detected in the water samples taken from the nearby streams. The results of soil analysis on the herbicide content were predictably erratic. The reasons for this could be attributed to many factors. For example, varying amounts of off-target spraying occurred; the sampling process was not totally systematic; and there was a long period of delay in analyzing all the samples stored in a freezer throughout the period. Viewing the individual test site separately, it is obvious that the level of herbicide suddenly diminished between 1 day and 1 week after application. In spite of the oversights and drawbacks of this project, it is encouraging that the methods of extraction and HPLC determination of the herbicide are adequate for future use. It is feasible to develop a low-budget monitoring program from local resources, the cost of which could be included in ongoing roadside spray operations. (Author's abstract)
W88-02358

MODELING THE FLOW OF IMMISCIBLE FLUIDS IN SOILS,
National Chunghsing Univ., Taichung (Taiwan). Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W88-02360

CHEMICAL CHANGES OF ORGANIC COMPOUNDS IN CHLORINATED WATER: XIII. GAS CHROMATOGRAPHIC-MASS SPECTROMETRIC STUDIES OF THE REACTIONS OF IRGASAN DP 300 (5-CHLORO-2-(2,4-DICHLORO-PHENOXY)PHENOL) WITH CHLORINE IN DILUTE AQUEOUS SOLUTION,
Tokyo Univ. of Science (Japan). Faculty of Pharmaceutical Sciences.
S. Onodera, M. Ogawa, and S. Suzuki.
Journal of Chromatography JOCRAM, Vol. 392, p 267-275, April 1987. 5 fig, 1 tab, 47 ref.

Descriptors: *Fate of pollutants, *Chemical reactions, *Irgasan DP 300, *Path of pollutants, *Pesticides, *Chlorination, *Phenols, *Degradation, Chlorine, Chromatography, Pesticides, Dioxins.

The reactions of Irgasan DP 300 with chlorine in water were investigated by means of gas chromatography (GC) and GC-mass spectrometry. Irgasan DP 300 was shown to produce dichloro- and trichloro-2-(2,4-dichlorophenoxy)phenols in chlorine-treated water, followed by the decomposition of these intermedieates to chlorophenols. No polychlorinated dibenzo-p-dioxins were detected in chlorine-treated Irgasan DP 300 solutions. The production of some of these compounds is dependent on the number of equivalents of chlorine per mol of compound and on the reaction pH. (Author's abstract)
W88-02361

CHARACTERIZATION AND DETERMINATION OF LIPOPHILIC HYDROCARBONS IN THE CHAO PHRAYA, BANG PAKONG AND THA-CHIN RIVERS AND THE UPPER GULF OF THAILAND,
Tokyo Univ. of Science (Japan). Faculty of Pharmaceutical Sciences.
S. Onodera, W. Chatkittikunrong, K. Saito, R. Phongbetchara, and M. Tabucanon.
Journal of Chromatography JOCRAM, Vol. 392, p 295-308, April 1987. 7 fig, 3 tab, 50 ref.

Descriptors: *Pollutant identification, *Water pollution sources, *Rivers, *Thailand, *Organic compounds, Rainfall, Hydrocarbons, Chromatography.

Carbon tetrachloride extracts of water samples collected from the Chao Phraya, Bang Pakong and Tha-Chin rivers and the Upper Gulf of Thailand in the rainy season (1983) and dry season (1984) were studied in order to characterize and determine the lipophilic hydrocarbons. The major lipophilic organic compounds present were n-alkanes (C17-C33), dibutyl phthalate and di(2-ehtylhexyl) phthalate. However, polyaromatic hydrocarbons were hardly detectable level (0.1 microgram(ug)/L by high-performance liquid chromatography). The concentrations of these lipophilic hydrocarbons were correlated with the effective rainfall content of the river. These data suggest a multiplicity of sources ranging from indigenous biological materials to petroleum activities. (Author's abstract)
W88-02362

ACIDOPHILIC HETEROTROPHIC BACTERIA ISOLATED FROM ACIDIC MINE DRAINAGE, SEWAGE, AND SOILS,
Mimasaka Women's Junior Coll., Okayama (Japan).
N. Kishimoto, and T. Tano.
Journal of General and Applied Microbiology JGAMA9, Vol. 33, No. 1, p 11-25, January 1987. 2 fig, 8 tab, 22 ref.

Descriptors: *Heterotrophic bacteria, *Isolation, *Mine wastes, *Acid mine drainage, *Wastewater, *Acidic water, *Iron bacteria, Aeration, Bacteria, Species composition, Growth.

Obligately acidophilic heterotrophic bacteria were isolated from weakly acidic environments such as sewage and soil as well as from acidic mine drainage. In the mine water, the bacterial populations ranged from 0 to 10,000 cells per ml of water or g of mud, moreover a large number of bacteria (10,000-1,000,000 cells per ml) were isolated from an aeration tank in which ferrous iron in the mine water was being oxidized to ferric iron by iron oxidizing bacteria. Although the population was small, 9 strains of bacteria of this type were found in 106 samples from the sewage and the soils. The bacterial characteristics of the strains isolated from acidic mine drainage were in good agreement with the genus Acidiphilium. However, the characteristics of the bacteria from weakly acidic environments differed from Acidiphilium in the pH growth range and sensitivity to organic substrates. The isolated bacteria were classified into 3 groups based on DNA base composition, cellular fatty acid composition, pH growth range and carbon sources for growth. (Author's abstract)
W88-02367

RELATIONSHIP BETWEEN LEAD CONCENTRATIONS IN SEAWATER AND IN THE MUSSEL MYTILUS EDULIS: A WATER-QUALITY CRITERION,
Victoria Coll., Clayton (Australia). Rusden Campus.
V. Talbot.
Marine Biology MBIOAJ, Vol. 94, No. 4, p 557-560, May 1987. 2 fig, 1 tab, 19 ref.

Descriptors: *Bioaccumulation, *Path of pollutants, *Lead, *Mussels, *Water quality, *Bioindicators, Monitoring, Mytilus, Regression analysis, Australia, Food chain.

Regression analysis on data collected from Port Phillip Bay and Western Port, Australia in 1979 shows that there is a significant equilibrium relationship between total recoverable lead in seawater and its concentrations in the mussel Mytilus edulis ($P < 0.001$). The concentration of lead in seawater should not exceed 1.27 microgram(ug)/L if the mussel is not to reach a lead concentration of 2.5 mg/kg wet weight, a value frequently used as a food standard for human consumption. When a lead value of 2.5 mg/kg wet weight is reached, the concentration factor by mussels for lead from seawater is 1 969. The critical value of 1.27 ug/L could be used as a marine water-quality criterion for lead in waters where mussels are harvested. (Author's abstract)
W88-02370

OPTIMIZING NONPOINT SOURCE CONTROLS IN WATER QUALITY REGULATION,
Florida Univ., Gainesville. Dept. of Food and Resource Economics.
For primary bibliographic entry see Field 5G.
W88-02378

GENERALIZED WATERSHED LOADING FUNCTIONS FOR STREAM FLOW NUTRIENTS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
D. A. Haith, and L. L. Shoemaker.
Water Resources Bulletin WARBAQ, Vol. 23, No. 3, p 471-478, June 1987. 6 fig, 6 tab, 30 ref.

Descriptors: *Nutrients, *Streamflow, *Model studies, *Watersheds, *Water pollution sources, *Path of pollutants, *Point sources, *Nonpoint sources, *Urban runoff, *Nitrogen, *Phosphorus, Runoff, Groundwater discharge, Erosion, Sediments, Prediction.

Loading functions are proposed as a general model for estimating monthly nitrogen and phosphorus fluxes in stream flow. The functions have a simple mathematical structure, describe a wide range of rural and urban nonpoint sources, and couple surface runoff and groundwater discharge. Rural runoff loads are computed from daily runoff and erosion and monthly sediment yield calculations. Urban runoff loads are based on daily nutrient accumulations rates and exponential wash off functions. Groundwater discharge is determined by lumped parameter unsaturated and saturated zone soil moisture balances. Default values for model chemical parameters were estimated from literature values. Validation studies over a three-year period for an 850 sq km watershed showed that the loading functions explained at least 90 percent of the observed monthly variation in dissolved and total nitrogen and phosphorus fluxes in stream flow. Errors in model predictions of mean monthly fluxes were: dissolved phosphorus - 4 percent; total phosphorus - 2 percent; dissolved nitrogen - 18 percent; and total nitrogen - 28 percent. These results were obtained without model calibrations. (Author's abstract)
W88-02386

COPPER UPTAKE BY THE WATER HYACINTH,
Akron Univ., OH. Dept. of Chemistry.
T. A. Lee, and J. K. Hardy.
Journal of Environmental Science and Health (A) JESEDU, Vol. 22, No. 2, p 141-160, February 1987. 8 fig, 1 tab, 16 ref.

Descriptors: *Path of pollutants, *Bioaccumulation, *Water hyacinth, *Copper, Roots, Biomass, Complexes, Ions, Diffusion, Plants.

Factors affecting Cu(+2) uptake by the water hyacinth (Eichornia crassipes) were examined. Two phases of copper uptake were observed throughout the uptake range (1-1000 mg/L). An initial rapid uptake phase of 4 hours followed by a slower, near linear uptake phase extending past 48 hours was observed. Stirring the solution enhanced uptake, suggesting copper removal is partially diffusion limited. Variations in pH over the range of 3 to 10 did not significantly affect uptake. Increasing the root mass of the plant increased the amount of copper taken up. As solution volume was increased more copper was removed. The presence of complexing agents during the uptake phase reduced copper uptake. The inability of complexing agents to recover all copper initially removed by a plant suggests a migration to sites within the plant. (Author's abstract)
W88-02400

COMPUTER MODELLING STUDY OF THE CHEMISTRY OCCURRING DURING CLOUD FORMATION OVER HILLS,
UKAEA Atomic Energy Research Establishment, Harwell (England).
For primary bibliographic entry see Field 2K.
W88-02402

POTENTIAL CONTRIBUTION OF SULFATE PRODUCTION IN CUMULUS CLOUD DROPLETS TO GROUND LEVEL PARTICLE SULFUR CONCENTRATIONS,
Upstate Freshwater Inst., Inc., Syracuse, NY.
A. P. Altshuller.
Atmospheric Environmental ATENBP, Vol. 21, No. 5, p 1097-1105, May 1987. 3 fig, 3 tab, 34 ref.

Descriptors: *Acid rain, *Path of pollutants, *Sulfates, *Clouds, *Cloud chemistry, *Fog, Sulfur dioxide, Particulate matter, Transport, Atmosphere, Sulfur.

The relationships have been examined between the presence or absence of cumulus clouds and 3rd quarter fine particle sulfur concentrations in St. Louis. An association between the presence of cumulus clouds with SO2 conversions in droplets and incrementally higher fine particle sulfur concentrations can be demonstrated. However, diurnal patterns of fine particle sulfur concentrations in the presence of cumulus clouds are not consistent with local contributions from sulfate formation in cumulus clouds. Morning fog often occurs on the same days on which cumulus clouds form later. Reactions of SO2 in fog droplets appear to make a contribution, but do not account for the major part of the increments in fine particle sulfur concentrations associated with cumulus clouds. The variations in fine particle sulfur concentrations observed can be explained if a substantial part of the sulfate formed in cumulus is transported upwards from the planetary boundary layer into the lower free troposphere. Subsequent multiday regional scale horizontal transport with concurrent gradual vertical transport of sulfate down to the surface precipitation and deposition of large quantities of calcium carbonate, and (6) altered chemistry of lake sediments regulating P availability. Mercury, benzene, chlorobenzene wastes from the plant have contaminated the sediments and fish of the lake. Deleterious effects of the facility have included: the elimination of fish habitat, exacerbation of the problem of limited O2 resources of the hypolimnion, contamination of fish flesh, exacerbation of the problem of low transparency of the lake, and severe O2 depletion in the lower waters of the river system. (Author's abstract)
W88-02403

THEORETICAL ASSESSMENT OF POLLUTANT DEPOSITION TO INDIVIDUAL LAND TYPES DURING A REGIONAL-SCALE ACID DEPOSITION EPISODE,
National Center for Atmospheric Research, Boulder, CO.
C. J. Walcek, and J. S. Chang.
Atmospheric Environmental ATENBP, Vol. 21, No. 5, p 1107-1113, May 1987. 8 fig, 20 ref. EPA Interagency Agreement DW930144-1.

Descriptors: *Model studies, *Path of pollutants, *Acid deposition, *Acid rain, Scavenging, Rainfall, Sulfates, Pollutants, Transport, Nitrates.

A mesoscale model of pollutant transport, transformation and deposition was used to perform a detailed analysis of acidic deposition to the states of New York and Ohio during a 3-day springtime deposition episode. This model can be used to assess the roles of wet and dry deposition to individual land types in the removal of pollutants from the atmosphere. Over two-thirds (67%, Ohio; 78%, New York) of the acidic deposition during this rainy period fell as wet deposition, primarily in the form of H2SO4. Dry deposition of SO2 accounted for 70-75% of the total dry acidic deposition in both areas, and most of the remaining dry deposition occurred as HNO3. Over both deposition areas, particulate sulfate deposition accounted for < 1% of the total acid deposition. Due to the highly surface-specific nature of the dry deposition process, individual land types displayed unique patterns of pollutant uptake. Water surfaces absorbed primarily SO2, while rougher forested areas absorbed a larger proportion of HNO3 vapor. Urban areas, with their associated material surfaces, were found to absorb significantly less acid in the dry form, and exists regarding the treatment of rainfall-wetted surfaces. These model results suggest that dry pollutant fluxes to individual surface types will show significant variability from any 'averaged' flux estimates over larger areas encompassing numerous land types. (Author's abstract)
W88-02404

OXIDATION OF SO2 IN RAINWATER AND ITS ROLE IN ACID RAIN CHEMISTRY,
Leeds Univ. (England). Dept. of Fuel and Energy.
A. G. Clarke, and M. Radojevic.
Atmospheric Environmental ATENBP, Vol. 21, No. 5, p 1115-1123, May 1987. 5 fig, 4 tab, 38 ref.

Descriptors: *Sulfur dioxide, *Oxidation, *Atmospheric chemistry, *Water chemistry, *Acid rain, Rainfall, Metals, Ions, Iron, Manganese.

A limited survey of rainwater composition covering 80 precipitation events was carried out to establish the levels of soluble metal ions which may influence the oxidation rate of SO2 in the aqueous phase. For 40 of the samples sodium sulfite was added at low concentrations and the rate of oxidation of S(IV) to S(V) established. The first order rate constant K sub S(IV) was found to vary over three orders of magnitude, from 100,000 to 100/s. pH and iron concentrations were found to be the most important factors affecting the rate. There was poor correlation between the rate of oxidation and the manganese, copper and zinc concentrations. The absolute values of the rate constants are lower than those used in recent modelling studies of atmospheric droplets and the importance of iron relative to manganese also differs from earlier studies. (Author's abstract)
W88-02405

WET DEPOSITION OF SULFATE AND ITS RELATIONSHIP TO SULPHUR DIOXIDE EMISSIONS,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
P. A. Clark, B. E. A. Fisher, and R. A. Scriven.
Atmospheric Environmental ATENBP, Vol. 21, No. 5, p 1125-1131, May 1987. 5 fig, 2 tab, 10 ref.

Descriptors: *Model studies, *Sulfates, *Sulfur dioxide, *Path of pollutants, *Acid rain, *Acid deposition, Rainfall, Oxidation, Scavenging.

The factors that need to be considered when comparing rainfall data with emission data are summarized, and it is indicated that trend analysis cannot be done properly without the use of a transport model. An optimization procedure is then used to fit the Fisher statistical model to European sulfur in rain data. This indicates moderately efficient to efficient wet removal of sulfate on average across Europe which is consistent with limited aqueous oxidation close to major source areas and a more linear behavior at greater distances. At such distances, particularly in remote high rainfall areas, the results demonstrate the importance of 'background' sulfate. The results are all consistent with the latest U.K. rainfall data. (Author's abstract)
W88-02406

SEQUENTIAL SAMPLING OF SNOW IN A RURAL AREA. EXPERIMENTATION AND IDENTIFICATION OF THE ACIDIFYING AGENTS,
Paris-7 Univ. (France). Lab. de Physico-Chimie de l'Atmosphere.
J. L. Colin, J. L. Jaffrezo, J. Pinart, and S. Roulette-Cadene.
Atmospheric Environmental ATENBP, Vol. 21, No. 5, p 1147-1157, May 1987. 11 fig, 4 tab, 28 ref.

Descriptors: *Acid rain, *Acid snow, *Water pollution sources, *Snow, *Acid deposition, *Salts, Inorganic acids, Acidification, Precipitation.

Analysis of soluble and insoluble fractions of samples taken sequentially during a wet deposition event has been used to follow the concentrations of the most important salts during the event and to determine their origin (marine, terrigenous or anthropogenic). By means of this sampling method it is possible to identify the inorganic acids present and to calculate their individual contributions to the acidification of the precipitation. (Author's abstract)
W88-02409

UNAVAILABILITY OF POLYNUCLEAR AROMATIC HYDROCARBONS FROM COAL PARTICLES TO THE EASTERN OYSTER,
Virginia Inst. of Marine Science, Gloucester Point.
M. E. Bender, M. H. Roberts, and P. O. deFur.
Environmental Pollution, Vol. 44, No. 4, p 243-260, 1987. 3 fig, 5 tab, 22 ref.

Descriptors: *Bioaccumulation, *Path of pollutants, *Water pollution effects, *Oysters, *Polycyclic aromatic compounds, *Coal dust, Leachates, Growth, Estuaries, Population exposure.

The accumulation by oysters of polycyclic aromatic hydrocarbons (PAH) from coal dust entering the estuarine environment has been postulated in the vicinity of coal transfer operations. Oysters Crassostrea virginica were exposed to coal dust plus 15 days leachate at concentrations of 10 mg/L and 1 mg/L coal dust for 28 days in a flow-through test system. Potential effects of the exposures were measured by comparing the uptake of PAH and the growth of the exposed animals an increase in PAH body burden over control animals provided the guts were first purged of particulates. Even at the high test concentrations (10 mg/L), no effect of the exposure on shell growth was observed. (Author's abstract)
W88-02421

MULTIVARIATE STOCHASTIC MODELLING OF GRASS FLUORIDE AND AIRBORNE FLUORIDES,
Newcastle upon Tyne Polytechnic (England). School of Mathematics and Statistics.
C. Craggs, and A. W. Davison.
Environmental Pollution, Vol. 44, No. 4, p 279-296, 1987. 1 fig, 9 tab, 17 ref.

Descriptors: *Model studies, *Fluorides, *Path of pollutants, *Air pollution, *Grasses, Rainfall, Scavenging, Atmosphere, Weather, Winds.

Stochastic modelling was used to investigate the influence of airborne fluorides (in the case of grass

fluoride) and meteorological factors on both grass and airborne fluoride levels, taking into consideration lagged dependence. Using rigorous grass sampling methods, there were indications of a negative relationship between volume of rainfall and grass fluoride concentrations, but no apparent relationship between the time which the leaf was visibly wet and grass fluoride levels. No evidence was found that rainfall washed airborne fluoride from the atmosphere or that wind variables influenced grass fluoride. For one particular experimental site, a multivariate stochastic model, which accounts for 81% of the total variation of the grass fluoride series, is developed. (Author's abstract)
W88-02422

DIGITAL SIMULATION MODEL FOR BRINE CONING IN UNCONFINED ANISOTROPIC AQUIFERS,
Centre for Water Resources Development and Management, Calicut (India).
For primary bibliographic entry see Field 2F.
W88-02441

BIOGENIC HYDROGEN SULFIDE EMISSIONS FROM SELECTED FLORIDA WETLANDS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
M. S. Castro, and F. E. Dierberg.
Water, Air, and Soil Pollution WAPLAC, Vol. 33, No. 1/2, p 1-13, March 1987. 1 fig, 6 tab, 24 ref.

Descriptors: *Biogenic emissions, *Hydrogen sulfide, *Wetlands, *Estuaries, *Acid rain, *Water pollution sources, *Limnology, Sulfur, Florida.

Biogenic H2S emissions from Florida wetland surfaces enclosed by transparent polycarbonate cylinders were collected on silver nitrate impregnated filters and analyzed fluorometrically. The areal emission rates ranged from 0.024 to 0.272 g S/sq m/y for a mangrove and from 0.001 to 0.110 g S/sq m/y for two freshwater wetlands (cypress swamp and riverine marsh) and a saltwater marsh. The total quantity of biogenic S emitted from these wetlands was estimated to range from 1.8 times 10 to the 9th power to 3.0 times 10 to the 9th power g/yr. While biogenic emissions from wetlands may be a factor in local patterns of acid deposition, they are probably insignificant contributors to Florida's atmospheric S burden and acidity of precipitation compared to anthropogenic S sources. (Author's abstract)
W88-02463

MERCURY IN SOILS, SEDIMENTS, AND CLAMS FROM A NORTH CAROLINA PEATLAND,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
R. T. Di Giulio, and E. A. Ryan.
Water, Air, and Soil Pollution WAPLAC, Vol. 33, No. 1/2, p 205-219, March 1987. 1 fig, 7 tab, 45 ref.

Descriptors: *Path of pollutants, *Mercury, *Sediments, *Clams, *Water pollution sources;, *Wetlands, *Land reclamation, *Bioaccumulation, *Peatlands, Drainage, Canals, Extraction, Ions, Tissue analysis.

Mercury concentrations were measured in samples of peat soils, sediments and clams (Rangia cuneata) from a peatland region of the Albemarle-Pamlico Peninsula of North Carolina. Total Hg concentrations in peat cores ranged from 40 to 193 ng/g (dw); no depth-related trends were noted. Mercury concentrations in surface sediments from canals draining the peatlands and from the Pungo River that receives this drainage ranged from 8 to 20 ng/g (dw). Selective extractions of these peat and sediment samples revealed that the bulk of the Hg was associated with organic matter-associated fractions (particularly humic/fulvic acid bound and organic-sulfide bound fractions). No Hg was detected in the relatively mobile and bioavailable water-soluble or ion-exchangeable fractions. Total Hg concentrations in the soft tissues of clams from the Pungo River ranged from 25 to 32 ng/g (ww). No concentrations of methyl Hg above the detection limit of a 25 ng/g were measured in soils, sediments, or clams. These data indicate that Hg concentrations in this region are at the low end of the distribution of levels reported for uncontaminated systems and that mining of these peatlands is unlikely to significantly elevate Hg concentrations in the receiving estuarine system. (Author's abstract)
W88-02470

REMOVAL OF METAL IONS FROM AQUEOUS SOLUTIONS BY PENICILLIUM BIOMASS: KINETIC AND UPTAKE PARAMETERS,
Tel-Aviv Univ. (Israel). Dept. of Botany.
M. Galun, E. Galun, B. Z. Siegel, P. Keller, and H. Lehr.
Water, Air, and Soil Pollution WAPLAC, Vol. 33, No. 3/4, p 359-371, April 1987. 3 fig, 5 tab, 34 ref.

Descriptors: *Path of pollutants, *Bioaccumulation, *Heavy metals, *Water pollution treatment, *Water treatment, *Biomass, *Penicilium, Kinetics, Ions, Metals, Cations.

The uptake and binding of Ni, Zn, Cd, and Pb by the mycelium of Penicillium digitatum are highly pH-sensitive, being severely inhibited below pH 3. In the case of Ni, Zn, and Cd, H(+) inhibits competitively. The Cu-ion, like UO2(2+) studied previously, is nearly pH-insensitive. All of these cations except Pb are taken up to a greater extent by mycelial preparations preheated at 100 C for 5 min. Other activators include alkali and dimethyl sulfoxide (DMSO) pretreatment, but formaldehyde inhibits, combining current and previous data, the ion-selective character of uptake is reflected, on a molar basis by the rank order Fe(3+), Ni(2+), Zn(2+) > Cu(2+) > Pb(2+) UO2(2+) >> MoO4(2-). P. digitatum appears to act like a mixture of neutral and acidic glycans with no real evidence for cationic amino-functional sites. In addition to the technological applications in water treatment, fungal biosorption may be of natural geochemical importance in the concentration of metals and formation of minerals. (Author's abstract)
W88-02472

EFFECT OF CULTIVATION ON SEDIMENT COMPOSITION AND DEPOSITION IN PRAIRIE POTHOLE WETLANDS,
National Fisheries Contaminant Research Center, Yankton, SD. Field Research Station.
For primary bibliographic entry see Field 2J.
W88-02477

ASSESSMENT OF THE INTERACTIONS OF METALS AND NITRILOTRIACETIC ACID IN SOIL/SLUDGE MIXTURES,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W88-02478

BEHAVIOR OF HYDROPHOBIC, ORGANIC MICROPOLLUTANTS IN DIFFERENT KARST WATER SYSTEMS: I. TRANSPORT OF MICROPOLLUTANTS AND CONTAMINANT BALANCES DURING THE MELTING OF SNOW,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
N. Simmleit, and R. Herrmann.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 1, p 79-95, May 1987. 5 fig, 2 tab, 59 ref.

Descriptors: *Karst hydrology, *Path of pollutants, *Catchment areas, *Organic compounds, *Snowmelt, *Hydrographs, Transport, Groundwater, Karst, Snow cover, Sinks.

During and after the melting snow, Karst groundwater of an agriculturally used and a wooded catchment area situated on a Dolomite plateau in Upper Franconia (F.R.G.) were investigated. Seventeen hydrochemical and hydraulic parameters were analyzed in the Karst water of two different springs in the course of the snow melting. Hydrograph analysis and the temporal variation of chloride concentrations were used to distinguish different types of Karst waters reaching the spring. Polycyclic aromatic hydrocarbons (benzo(a)pyrene, fluoranthene, benzo(ghi)perylene) and chlorinated pesticides (alpha-BHC, lindane) are transported in Karst waters adsorbed on suspended solids, dissolved in water and adsorbed on dissolved humic material. Most of the organic contaminants reach the groundwater level with conduit and trickle water. However, BHC-molecules also arrive at the spring with seepage water three weeks after the meltwater input. Using Karst springs as natural lysimeters for their catchment areas, pollutant input-output balances were calculated for PAHs and BHCs revealing that 87.5 to 99.7% of the atmospheric micropollutants released from the snow cover are retained in the Karst system. Potential pollutant sinks are proposed and discussed. (See also W88-02481) (Author's abstract)
W88-02480

BEHAVIOR OF HYDROPHOBIC, ORGANIC MICROPOLLUTANTS IN DIFFERENT KARST WATER SYSTEMS: II. FILTRATION CAPACITY OF KARST SYSTEMS AND POLLUTANT SINKS,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
N. Simmleit, and R. Herrmann.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 1, p 97-109, May 1987. 3 fig, 5 tab, 40 ref.

Descriptors: *Karst hydrology, *Path of pollutants, *Catchment areas, *Organic compounds, Transport, Groundwater, Karst, Precipitation, Water analysis, Sinks.

In weekly intervals water samples of bulk precipitation and different Karst waters from the vadose and phreatic zone of two hydrogeologically and hydrochemically different Karst catchment areas in Upper Franconia (F.R.G.) were taken. Water samples and additional soil, residual loam and sinter samples were analyzed for benzo(a)pyrene, fluoranthene, benzo(ghi)perylene by HPTLC and alpha-BHC, lindane by GC. Furthermore, partition coefficients of these micropollutants between carbonate water and top soil material, residual loam and dolomite were determined. The calculation of effective equilibrium coefficients between soil water and soil of ambient Rendolls revealed that the thin soil layer of Karst terrains acts as major pollutants sink. Furthermore, co-precipitation of pollutants can occur during the precipitation of dissolved humic material. However, due to rapid percolation of soil and Karst waters 0.3 to 3.3% of the deposited contaminants can reach the groundwater. (See also W88-02480) (Author's abstract)
W88-02481

ORGANOCHLORINE PESTICIDE CONTENTS OF TRIBUTARIES INTO BLANCA BAY, ARGENTINA,
Instituto Argentino de Oceanografia, Buenos Aires. Lab. de Quimica Marina.
H. V. Zubillaga, J. L. Sericano, and A. E. Pucci.
Water, Air, and Soil Pollution WAPLAC, Vol. 32, No. 1/2, p 43-53, January 1987. 4 fig, 2 tab, 17 ref.

Descriptors: *Path of pollutants, *Estuaries, *Blanca Bay, *Organochlorine compounds, *Pesticides, Water analysis, Organic compounds, Argentina, Streams.

Thirteen replicate water samples from streams emptying into Blanca Bay, Argentina, were taken to study the environmental quality of the surface waters. Of eleven chlorinated pesticides, five were detected in all the sampling places as both dissolved and adsorbed species: alpha-HCH, gamma-HCH (lindane), heptachlor, delta-HCH, and aldrin. The concentrations were in the following ranges: alpha-HCH = 3 to 68 ng/L and 9 to 239 ng/g, lindane = 2 to 42 mg/L and 10 to 542 ng/g, heptachlor = 5 to 32 ng/L and 9 to 390 ng/g, delta-HCH = 1 to 10 ng/L and n.d. to 87 ng/g, and aldrin = 1 to 7 ng/L and n.d. to 33 ng/g for filtered water and suspended matter samples, re-

spectively. Heptachlor epoxide, dieldrin, o-p'DDD, and p-p'DDT were present in solution at only one sampling site whereas p-p'DDD and o-p'DDT were not detected. The analyses revealed a non-uniform distribution of these compounds over the studied area. The higher concentrations of organochlorines were detected downstream from urban areas. (Author's abstract)
W88-02483

ACIDIFICATION OF NOVA SCOTIA LAKES: III ATMOSPHERIC DEPOSITION OF SO4 AND NO3 AND EFFECTS ON URBAN AND RURAL LAKES,
Nova Scotia Dept. of the Environment, Halifax.
J. K. Underwood, J. G. Ogden, J. J. Kerekes, and H. H. Vaughn.
Water, Air, and Soil Pollution WAPLAC, Vol. 32, No. 1/2, p 77-88, January 1987. 5 tab, 42 ref.

Descriptors: *Water pollution sources, *Lakes, *Limnology, *Acid rain, *Acid deposition, *Sulfates, *Nitrates, Urban areas, Rural areas, Water chemistry, Rainfall.

Although water chemistry of precipitation and lakes in Nova Scotia is dominated by Cl from sea salt, correction for marine influence reveals that the dominant anion in acidified lakes is SO4. Atmospheric deposition of non-marine SO4(SO4*) and NO3-N for the period 1977-1980 at 4 stations in southwest Nova Scotia averaged 47 meq SO4*/sq m/y and 21 meq NO3-N/sq m/y compared with 38 and 13 meq, respectively, for the average of 3 stations in the northeastern third of the province. Precipitation pH increased from 4.5 to 4.8 along the same axis. Almost 50% of the SO4 deposition occurred when storms came from the southwest, indicating low pressure tracks which pass south of major Canadian sources of S. SO4* deposition in metropolitan Halifax (1982 bulk data) was 87 meq/sq m/y, due to local emissions of ca.28300 ton S in the area, as well as LRTAP. Concurrent deposition of NO3-N was 15 meq/sq m/y (2.1 kg/ha/y). Loadings from SO4 deposition in the Halifax area amount to 42 kg/ha/y and clearly exceed the federal guideline of 20 kg/ha/y. Water chemistry of southwest, northeast, and Halifax area lakes show the same general SO4* trends as observed for atmospheric deposition. In addition a positive relationship between SO4* concentrations in the urban lakes and proximity to the center of the urban area is found. (Author's abstract)
W88-02484

INCIDENCE OF ANTIBIOTIC RESISTANT BACTERIA IN DRINKING WATER IN CAIRO,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
H. T. El-Zanflay, E.-S. A.-A. Kassim, and S. M. Badr-Eldin.
Water, Air, and Soil Pollution WAPLAC, Vol. 32, No. 1/2, p 123-128, January 1987. 3 tab, 17 ref.

Descriptors: *Bacteria, *Drinking water, *Antibiotic resistance, Taxonomy, Species diversity, Pollutant identification, Cairo, Chlorination, Disinfection, Water treatment, Public health.

The presence of antibiotic resistant bacteria was found among standard plate count (SPC) populations of chlorinated drinking water from two districts in Cairo. SPC values obtained were low, ranging between 20 and 3800/mL. Most strains appeared to be ampicillin resistant (89.7%). Those were followed by sulfaguanidine (78.1%) and streptomycin (56.9%). The majority of the tested strains were resistant to two or more antibiotics (multiple antibiotic resistant, MAR) which represent 62.4 to 98% of the total isolates of the mean obtained in a month. Identification of 363 MAR strains revealed that gram-positive rods were dominant in chlorinated drinking water. Gram-negative fermentative-rods, gram-positive cocci and gram-negative nonfermentative rods represent the second, third and fourth group of the identified MAR phenotypes. The impact of the antibiotic resistant bacteria in drinking water as a health hazard is discussed. (Author's abstract)
W88-02486

SEDIMENT TRACE METAL CONTAMINATION IN THE IVORY COAST, WEST AFRICA,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
I. Kouadio, and J. H. Trefry.
Water, Air, and Soil Pollution WAPLAC, Vol. 32, No. 1/2, p 145-154, January 1987. 2 fig, 4 tab, 23 ref. NSF Grant INT-8311516.

Descriptors: *Water pollution sources, *Sediments, *Trace metals, *Heavy metals, Ivory Coast, Mercury, Lead, Zinc, Wastewater.

To help expand global perspective on trace metal contamination, concentrations of Cu, Fe, Hg, Mn, Ni, Pb, and Zn were determined for sediments from the Ebrie Lagoon in the Ivory Coast, a developing West African nation. Excess loading of several metals, especially Hg, Pb, and Zn was found at several sites. The maximum concentration of Hg measured in sediments from the Ebrie Lagoon (2250 ng/g) is about 30 times greater than natural levels. Similarly, Pb and Zn concentrations for the Ivorian lagoonal sediments are as high as 250 and 560 microgram/g, respectively, showing sizeable anthropogenic inputs. Trace metal sources to the Ebrie Lagoon include untreated sewage and industrial wastes. (Author's abstract)
W88-02487

HISTORY OF AIRBORNE POLYCYCLIC AROMATIC HYDROCARBONS (PAH) AND PERYLENE AS RECORDED IN DATED LAKE SEDIMENTS,
Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Elintarvikelaboratorio.
K. Wickstrom, and K. Tolonen.
Water, Air, and Soil Pollution WAPLAC, Vol. 32, No. 1/2, p 155-175, January 1987. 5 fig, 4 tab, 35 ref.

Descriptors: *Water pollution sources, *Lakes, *Limnology, *Polycyclic aromatic hydrocarbons, *Sediment cores, Catchment areas, Finland, Sediments, Perylene.

Polycyclic aromatic hydrocarbons (PAH) were analysed in sediment cores from five small forest lakes in Finland. The catchments of the lakes were undisturbed (2 lakes) or only very slightly disturbed by human activity (3 lakes). None of the lakes had runoff delivery of PAH from their shores. Lead-210 dating of four lakes enabled the calculation of individual PAH fluxes over the past 100 to 150 yr. The sedimentary distribution of abiotic PAH in these lakes appears to be indicative of the development of combustion-generated energy production in Finland and adjacent countries. This development is reflected in an overall increase in sedimentary PAH since about 1850. After World War II the rate of accumulation of PAH continues to increase. The large variation between the PAH fluxes of different lakes indicates different trapping efficiencies and/or preservation of the PAH compounds due to limnological differences between the lakes. (Author's abstract)
W88-02488

MODIFICATIONS IN PHOSPHORUS LOADING TO ONONDAGA LAKE, U.S.A., ASSOCIATED WITH ALKALI MANUFACTURING,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, and E. M. Owens.
Water, Air, and Soil Pollution WAPLAC, Vol. 32, No. 1/2, p 177-182, January 1987. 5 fig, 19 ref.

Descriptors: *Water pollution sources, *Lakes, *Limnology, *Phosphorus, *Industrial wastewater, Ions, Pollution load, Onondaga lake, Seasonal variation.

The effects of an alkali production facility on P loading to the epilimnion of Onondaga Lake are documented for the spring to fall interval of 1980 and 1981. The effects include additional load to the epilimnion from the hypolimnion and the outlet, and reduced loads from dense, ion-enriched inflows. Despite the compensating effects, the load received by the epilimnion from spring through fall is greater than previously estimated as a result of the manufacturing operations. (Author's abstract)
W88-02489

RESIDUES OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN THE SPRING RIVER, MISSOURI,
Missouri Cooperative Fishery Research Unit, Columbia.
R. L. Crunkilton, L. M. Smith, J. D. Petty, and R. D. Kleopfer.
Water, Air, and Soil Pollution WAPLAC, Vol. 32, No. 1/2, p 219-231, January 1987. 3 fig, 1 tab, 43 ref.

Descriptors: *Path of pollutants, *Dioxins, *Population exposure, Tissue analysis, Food chains, Population exposure, Fate of pollutants, Fish, Mollusks, Bioaccumulation.

Contamination of the Spring River in southwest Missouri by 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) is believed to result from several well-defined point source waste disposal sites. Analyses of 31 fish samples and samples of crayfish, mussels, other aquatic invertebrates, and sediments collected in 1981-1983 demonstrated a rapid decline in TCDD levels in biota both upstream and downstream of the area of contamination and are believed to indicate a continuing, long term input of TCDD into the river. Mean concentrations of TCDD 0.5 km dounstream from the area of contamination were 38 parts per trillion (pptr) in whole fish and 20 pptr in fish fillet; mean concentrations beyond 14 km downstream were below 4 pptr in both whole fish and fillets. Caged mussels (65 day exposure) did not accumulate TCDD (detection limit, 10 pptr). High fish consumption by local sportsmen may indicate maximum permissible concentrations of less than 5 pptr. in fish fillets. (Author's abstract)
W88-02491

BIOAVAILABILITY OF SEDIMENT-SORBED ORGANIC CHEMICALS: A REVIEW,
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
J. P. Knezovich, F. L. Harrison, and R. G. Wilhelm.
Water, Air, and Soil Pollution WAPLAC, Vol. 32, No. 1/2, p 233-245, January 1987. 101 ref. EPA Interagency Agreement (EPA-79-D-X0856) and DOE Contract W-7405-Eng-48.

Descriptors: *Reviews, *Path of pollutants, *Water pollution effects, *Organic compounds, *Bioavailability, *Sediments, *Adsorption, Food chains, Public health, Bioaccumulation.

Xenobiotic chemicals that are present in aquatic environments are typically concentrated on suspended particles and sedimentary materials where they represent a source of chronic contamination to benthic and pelagic organisms. Laboratory and field studies of bioaccumulation, toxicity, and food-chain transfer of chemicals bound to sediment have shown the potential ecological impacts that may result from the contamination of sediments. In this review, the chemical and physical processes that determine the environmental fate of sediment-sorbed organic chemicals are outlined, and their relationship to bioavailability is discussed. Methods currently used to predict the fate of pollutants in the aquatic environment are of limited use for the assessment of sediment-sorbed chemical bioavailability because they are based on the compound's behavior in the water column. Furthermore, an organism's morphology and ecological niche can profoundly affect its ability to accumulate xenobiotic chemicals from sediments and these must be considered before the population at greatest risk can be identified. (Author's abstract)
W88-02492

5C. Effects Of Pollution

ENVIRONMENTAL IMPACTS OF SLUDGE DISPOSAL,
New York State Coll. of Agriculture and Life Sciences, Ithaca.
R. C. Loehr.

IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 179-196, 2 fig, 6 tab, 6 ref.

Descriptors: *Environmental effects, *Sludge disposal, *Waste disposal, Air pollution, Water pollution, Legislation, Social aspects, Sludge.

The disposal of sludge is a complex problem that can affect the air, land and water. It requires consideration of human and animal health, plant growth and nuisances, as well as protection of groundwater and surface water. Proper operation, maintenance and monitoring of sludge utilization or disposal practices is essential to avoid adverse environmental impacts. Reflecting the public interest in environmentally sound sludge management approaches, sludge disposal is subject to legislative and social constraints: federal and state laws and regulations on disposal and reuse; public and private incentives for conventional and alternative wastewater treatment processes; and social attitudes toward waste disposal and reuse. Federal legislation affecting sludge management and disposal, and the impact of such legislation on sludge management are shown in tabular form. Sludge is the inevitable product of our standard of living and desire for a better environment. Sludge must be considered as a potential threat to the environment (negative impact) and as a potential resource that should be utilized (positive impact). Environmentally sound and economic methods of sludge disposal must be utilized. The adverse environmental impacts of various methods of sludge disposal are discussed because these are of the greatest concern to the public. (See also W88-01499) (Lantz-PTT)
W88-01514

IMPACT OF SLUDGE INCINERATION ON THE ENVIRONMENT,
Camp, Dresser and McKee, Inc., Boston, MA.
W. R. Niessen.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 197-210, 3 fig, 7 tab, 3 ref.

Descriptors: *Environmental effects, *Sludge disposal, *Incineration, Air pollution, Waste disposal, Industrial wastes, Sludge drying, Ash.

The primary impacts associated with sludge incineration that fall into the air pollution and energy categories are discussed. Air pollution can be a significant impact from sludge incineration, particularly for older plants equipped with inadequate air pollution control equipment. However, modern plants, or older plants that have been upgraded, produce air emissions that are modest, particularly in view of the relatively small amounts of sludge generated in most treatment plants. Impacts in the energy area may be minimized or essentially eliminated by the use of available high-performance sludge dewatering devices, such as the belt press and the filter press. Through proper selection of a furnace concept, fossil fuel use can be limited to startup and ash transportation. Energy recovery practiced with sludge incineration can offset in-plant fuel use for heat and hot water and, if appropriate nearby energy markets can be found, may even generate revenue and reduce or eliminate fossil fuel combustion in the boilers of the energy purchaser. Sludge incineration need not, and should not, be considered as an environmentally unsound approach to sludge management. Proper design and operation to mitigate air pollution and substantially eliminate wasteful energy use is practical and realistic. When coupled with careful landfill design and operation to avoid water pollution from ash disposal, incineration systems provide positive control of health impacts and of impacts on biota associated with sludge disposal. (See also W88-01499) (Lantz-PTT)
W88-01515

MONITORING THE RESPONSE OF SOILS AND CROPS TO SLUDGE APPLICATIONS,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
L. E. Sommers, and D. W. Nelson.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 217-239, 13 tab, 54 ref.

Descriptors: *Environmental effects, *Monitoring, *Sludge disposal, *Agriculture, Soil contamination, Wastewater disposal, Nitrogen, Cadmium, Hydrogen ion concentration, Heavy metals, Phosphorus, Potassium.

The effect of sewage sludge applications on the chemical composition of soils and crops can be readily monitored. Because of the natural horizontal and vertical heterogeneity of soils, a sound soil sampling program is needed to obtain statistically valid data on sludge-induced changes in soil properties. Similarly, the concentrations of many macro- and micronutrients and heavy metals in crops are increased by sludge application to soils. Since crop species and cultivar of the same species differ markedly in metal uptake, samples of crops must be obtained from both sludge-treated and control areas to evaluate the impact of sludge applications on plants. Emphasis has been placed on analyzing metals in the edible part of the plants (e.g., grain, fruit, tuber or forage) to obtain data relative to human health. The extent of soil and crop monitoring required depends on the sludge application rates used. If sludge application rates are consistent with the amount of N required by the crop and the limitations on Cd and sludge stabilization, no monitoring of crops is needed. Since soil pH is the primary factor governing plant uptake of heavy metals (e.g., Zn, Cu, Ni and Cd), soils must be monitored routinely to ensure that the pH is 6.5 or above whenever food-chain crops are grown. In addition, routine soil testing for available P and K is recommended so that supplemental fertilizer P and K can be applied, if needed, to optimize crop yields. More extensive soil and crop monitoring is required if sludge application rates exceed current recommendations for agriculture land, the major considerations being Cd accumulation in crops; NO3(-) leaching into groundwaters; accumulation of Pb, Zn, Cu and Ni in soils; and maintenance of soil pH at 6.5 or above. (See also W88-01499) (Lantz-PTT)
W88-01517

LAND DISPOSAL EFFECTS ON GROUNDWATER,
Michigan Dept. of Public Health, Lansing. Bureau of Environmental Occupational Health.
W. A. Kelley.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 259-262.

Descriptors: *Land disposal, *Groundwater quality, *Environmental effects, Standards, Wastewater treatment.

Previous discussions of the Water Quality Standards and how those proposed standards brought about consideration of the Ground Water Quality Standards indicate how regulations (particularly stringent, narrow point-of-view regulations) can breed more regulations. The public water supply program in Michigan managed to do an efficient job of protecting public health for many years with few administrative rules. While it may be difficult to continue to operate in that fashion, it is preferable to the threat of overregulation. Great care should be taken to ensure that regulations are neither requested nor approved unless there is a documented need for them. This is a difficult task when dealing with federal environmental programs because the impact of the federal bureaucracy is tremendous. The debate as to whether wastewater sludge is a resource to be utilized or a waste to be disposed of properly will undoubtedly continue. It is possible to summarize the discussion simply by saying that if sludge can be used as a resource and properly controlled to avoid contamination of water, crops, and animals, it is an excellent method of disposal. (See also W88-01499) (Lantz-PTT)
W88-01519

CADMIUM EFFECTS ON MYCORRHIAGE: A RESEARCH NEED IN FORESTLAND APPLICATION OF SLUDGE,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
J. W. Bulkley.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 263-270, 1 tab, 13 ref.

Descriptors: *Cadmium, *Water pollution effects, *Mycorrhizae, *Forests, *Sludge disposal, Waste disposal, Environmental effects, Heavy metals, Wastewater disposal, Land disposal.

Since the passage of The Water Pollution Control Act Amendments of 1972 (PL 92-500) and the Clean Water Act of 1977 (PL 95-217), municipalities throughout the United States have been working to improve the performance and capability of their wastewater treatment plants. One goal of the federal legislation has been for all municipalities to provide a level of treatment at least equal to secondary treatment. One direct result of the enhanced treatment of wastewater is a significant increase in the production of solids (sludge) at these treatment plants. Consequently, one component of improved performance of the treatment plants is to implement means of reliable disposal of the sludge removed from the wastewater flow at the plant. Issues associated with land application of municipal wastewater treatment plant effluents and sludges to forest land are important research topics. This chapter represents a brief status report on one component of this important issue, namely, the fate of heavy metals that may be present in the wastewater treatment plant sludge. In particular, it is important to establish whether the application of these sludges to forest land will minimize the possible adverse environmental impacts of toxic heavy metals. It is important to establish under what conditions forest land application of sludge containing toxic heavy metals will be effective and environmentally sound. (See also W88-01499) (Lantz-PTT)
W88-01520

FILLING IN OF HARBOUR BASINS WHICH CONTAIN CONTAMINATED SILT,
Rotterdam Public Works Dept. (Netherlands).
M. Veltman.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 36-51, 6 fig, 5 ref.

Descriptors: *Harbors, *Contaminated sediments, *Water pollution effects, *Silt, *Dredging, Groundwater pollution, Tides.

Much more consideration must be given to the influence of civil engineering works on the biotic and abiotic environment than was given previously. The reasons for this are the large scale of the projects, the increasing shortage of space, and the increasing use of substances which may pollute the environment. These problems arise not only during the dredging and disposal of silt, but the ground is also being contaminated to an increasing degree on inland sites. Every project requires individual assessment. Using an example taken from the boundary between land and water, the influence which the type of work and possible concentrations of contaminants may have upon the environment are set out. The means for the possible dispersion of these contaminants can also be determined. A harbor basin with polluted silt on the bottom may be filled in by the use of a specially adapted method in which the contaminated silt is not removed by dredging but is carefully covered by a layer of sand in which a protective clay layer has been sandwiched. Direct contact with the contaminated silt is not possible because of the use of the covering layer. The effect of polluted groundwater in the environs of the harbor is very limited. Only after some time will the contaminants enter the water remaining in the part of the harbor which has not been filled. The tidal flow will effect a further dilution and for this reason the possible increase in the concentration of contaminants in the water of the harbor will not be measurable. From the example given it appears that it is important to be able to describe the processes. If the effects of pollution are known, then the best solution can be chosen. (See also W88-01522) (Lantz-PTT)
W88-01526

BENTHIC RESOURCES ASSESSMENT TECHNIQUE, A METHOD FOR QUANTIFYING THE EFFECTS OF BENTHIC COMMUNITY CHANGES ON FISH RESOURCES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. D. Lunz, and D. R. Kendall.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 84-95, 5 fig, 2 tab, 29 ref.

Descriptors: *Benthic environment, *Environmental effects, *Waste disposal, *Fish, *Dredging, Sediments, Contaminated sediments, Benthic Resources Assessment Technique, Biomass.

Preoperational baseline characterizations and postoperational monitoring strategies associated with dredged material disposal in the coastal zone commonly document changes in sediment and benthic invertebrate communities inhabiting those sediments. The US Army Engineer Waterways Experiment Station is developing and field-testing a technique that uses benthic invertebrate community data to make quantitative statements about the feeding habitat value to fish of natural bottoms and bottoms modified by dredged material disposal or other activities influencing substrate quality. The technique, called Benthic Resources Assessment Technique (BRAT), employs two different types of information from a project area. A list of the bottom-feeding fishes inhabiting a project area is used to select the benthic resources important to an impact assessment. As the first step, observations and measurements of the morphology of specimens of these species are carried through a data reduction and analysis sequence that assigns each fish to a feeding strategy class or guild that appears to correlate with potential prey size and a prey's location (depth) below the sediment surface. The second step involves the analysis of information from a benthic macroinfaunal invertebrate community survey. The BRAT then classifies the invertebrate taxa according to their size and the distribution of their biomass relative to the sediment surface. Estimates of standing crop complement this classification scheme. When combined, the two types of information provide an estimate of the potential prey biomass (grams/sq m) or energy (kilocalories/sq m) available to the fish in a particular feeding guild. (See also W88-01522) (Author's abstract)
W88-01531

LONG-TERM MONITORING OF CE HABITAT DEVELOPMENT ON DREDGED MATERIAL SITES, 1974-84,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
M. C. Landin, and C. J. Newling.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 102-105.

Descriptors: *Monitoring, *Ecological effects, *Dredging, *Disposal sites, *Waste disposal, *Virginia, Wetlands, Georgia, Florida, Texas, California, Oregon, Connecticut, Water quality, Environmental effects, Alabama, Minnesota, Michigan, Louisiana.

Over the past 11 years, seven dredged material sites located in US waterways have been planned, constructed, planted, and monitored by the US Army Engineer Waterways Experiment Station (WES). Wetland sites are located at Windmill Point in the James River, Virginia; Buttermilk Sound in the Altamaha River, Georgia; Drake Wilson Island in Apalachicola Bay, Florida; Bolivar Peninsula in Galveston Bay, Texas; Salt Pond 3 in south San Francisco Bay, California; and Miller Sands Island in the Columbia River, Oregon. Upland sites are located at Nott Island in the Connecticut River, Connecticut; Bolivar Peninsula; and Miller Sands. In addition, four dredged material sites developed by Corps Districts are being monitored formally by WES, and several are being monitored informally at other site visits. Southwest Pass at the mouth of the Mississippi River, Louisiana (New Orleans District), and Lake of the Woods at Warroad, Minnesota (St. Paul District), are wetland sites only; Gaillard Island in lower Mobile Bay, Alabama (Mobile District), and Pointe Mouillee in western Lake Erie, Michigan (Detroit District), are both wetland and upland sites. Research and development of these eleven sites has shown that habitat development is feasible and that habitats can be successfully developed on dredged material under a variety of site-specific conditions. Each of the sites described has served as a representative of habitat types found in US waterways, and each has shown that it can be developed into a beneficial use fairly quickly. This development usually takes less than 3 years. The wetland sites have exceeded early expectations, while the upland sites have been less successful. Data gained from long-term monitoring of these developed sites can be extrapolated to other potential wetland development sites. (See also W88-01522) (Lantz-PTT)
W88-01533

HEAVY METAL POLLUTION FROM MINING IN GREENLAND,
Groenlands Fiskeri- og Miljoeundersoegelser, Copenhagen (Denmark).
P. Johansen, M. M. Hansen, and G. Asmund.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 685-693, 6 fig, 1 tab, 2 ref.

Descriptors: *Heavy metals, *Mine wastes, *Greenland, *Water pollution effects, *Path of pollutants, *Water pollution sources, Lead, Zinc, Cryolite, Mussels, Waste disposal.

Studies on the impact of mining on the environment have been conducted at three mines in Greenland. These include a lead-zinc mine and a cryolite mine in West Greenland, both in operation, and an abandoned lead-zinc mine in East Greenland. Widespread dispersal of heavy metals from the mining operations have taken place at all three mines, and very high levels of lead and sometimes zinc are found in blue mussels and seaweed in the intertidal zone of the sea. The sources of the polluting metals are somewhat different at the mines. The most important sources seem to be tailings disposal to the sea, airborne spreading of dust containing metals, melting water and precipitation draining piles of concentrate or tailings left on land. Work is being undertaken to reduce the adverse environmental impact at the three mines. (See also W88-01554) (Author's abstract)
W88-01562

BIOGENIC NATURE OF CORROSIVITY OF SULPHIDE DEPOSITS MINE WATER AND SOME OF ITS GEOCHEMICAL AND MINING-TECHNICAL IMPACTS,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
V. M. Panteleev, G. A. Volkov, and V. I. Kuzkin.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 759-764, 2 ref.

Descriptors: *Water pollution effects, *Corrosivity, *Sulfides, *Mine water, Geochemistry, Aerobic bacteria, Microbiological studies, Sulfuric acid, Ferric sulfate, Carbon dioxide, Chemical reactions, Chemical analysis.

Any ore deposit under production represents an open thermodynamic system. The composition and properties of the solid, liquid and gaseous phases of this system changed under the physical-chemical conditions of weathering. In sulfide deposits in underground mine workings, a sharp activation of these processes takes place under the impact of aerobic autotrophic and heterotrophic microorganisms. This is followed by mine water enrichment with biogenic components (sulfuric acid, ferric sulfate, organic complexes, carbon dioxide) and formation of corrosive mine water. The impact of this water on ore and rock-forming minerals causes irreversible changes in their crystalline-chemical structure, decrease in strength and elastic properties, and leaching of metals. This results in lessening stability of ore and enclosing rock, ore impoverishment, destruction of concrete mine linings, corrosion of metal construction and mining electrical equipment, and the possibility of surface water contamination by mine water. (See also W88-01554) (Lantz-PTT)
W88-01568

WASTES IN MARINE ENVIRONMENTS.
Office of Technology Assessment, Washington, DC.
For primary bibliographic entry see Field 2L.
W88-01667

HYDROGEOLOGIC EVALUATION OF THE EFFECTS OF SURFACE APPLICATION OF SEWAGE SLUDGE TO AGRICULTURAL LAND NEAR ROCKTON, ILLINOIS,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 5B.
W88-01672

ANTHROPOGENIC ANOXIFICATION ('EUTROPHICATION') OF THE WATER TABLE REGION OF A DEEP PHREATIC AQUIFER,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 5B.
W88-01688

EFFECT OF BIPHENYL ETHER HERBICIDES ON THE FORMATION OF MUTAGENIC INTERMEDIATES FROM PROCARCINOGENS BY RAINBOW TROUT,
Hakodate Junior Coll. (Japan).
M. Miyauchi, and T. Uematsu.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 2, p 175-181, August 1987. 2 tab, 16 ref.

Descriptors: *Water pollution effects, *Biphenyl ethers, *Herbicides, *Trout, *Agricultural chemicals, Procarcinogens, Mutagens, Fish, Tumors, Fish diseases, Toxicity.

Biphenyl ether herbicides are used worldwide and are suspected of inducing the growth of tumors in fish living in herbicide-contaminated waters. The effects of biphenyl herbicides and related compounds on the formation of mutagenic intermediates from procarcinogens by the S-9 fraction from rainbow trout were examined using the Salmonella/microsome test. It was found that the biphenyl ether herbicides and their related compounds enhanced the mutagenicity of procarcinogens. Biphenyl ether herbicides are dechlorinated in the environment by various factors, such as sunlight, and would therefore be detected in their dechlorinated forms including 4-nitrobiphenyl ether and 4'-chloro-4-nitrobiphenyl ether. When fish contaminated by biphenyl ethers encounter procarcinogens such as amines and amides, the risk of carcinogenicity is increased. (Wood-PTT)
W88-01715

TOXICITY OF CRUDE OIL TO THE METABOLISM OF FRESHWATER MINOR CARP, PUNTIUS SOPHORE,
Bihar Univ., Muzaffarpur (India). Dept. of Zoology.
M. S. Prasad.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 2, p 188-193, August 1987. 1 fig, 2 tab, 14 ref.

Descriptors: *Toxicity, *Water pollution effects, *Oil pollution, *Carp, *Fish physiology, *Respiration, Fish metabolism, Lethal limit, Mortality, Sublethal effects, Oil.

The effects of crude oil on the rate of metabolism in freshwater fishes have not been investigated fully. Therefore, the in vitro respiration rate and the overall in vivo respiration rate of the freshwater minor carp, Puntius sophore, was measured after exposing the fish to different doses of crude oil extract for varying periods. The respiration rate in vivo declined in almost all of the six concentra-

tions of crude oil examined. The percent decrease in oxygen uptake rate with respect to the oil concentrations at different exposure periods was plotted. The overall metabolism decreased 50% after 96 hours exposure at a concentration of 200 ppm, but a decrease of only 37.5% was recorded after 168 hours at the same concentration. The measurement of respiration rate in vitro revealed that crude oil inhibited the respiration rate of all the experimental tissues. When the fish breathing rate increases, a larger amount of the toxicant comes in contact with the secondary lamellae of the gill causing damage to the respiratory epithelium. Puntius sophore, before it succumbs to lethal doses of crude oil, demonstrates an increased breathing rate. (Wood-PTT)
W88-01716

TOXICITY OF VANADIUM TO DIFFERENT FRESHWATER ORGANISMS,
Lisec VZW, Ghent (Belgium).
J.-M. Beusen, and B. Neven.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 2, p 194-201, August 1987. 1 fig, 4 tab, 15 ref.

Descriptors: *Water pollution effects, *Toxicity, *Vanadium, *Crustaceans, *Fish, Daphnia, Mortality, Lethal limit, Heavy metals, Water pollution sources, Aquatic life, Aquatic environment.

The natural concentration of vanadium which is as abundant as nickel and zinc in the earth's crust in the aquatic environment is low since vanadium usually does not occur as the free metal, but as relatively insoluble minerals and organo-metallic complexes. However, anthropogenic input has led to a significant enrichment of vanadium in the environment; the sources of vanadium contamination were briefly discussed. Previous vanadium toxicity tests were reviewed and the acute and subchronic toxicity of vanadium were determined for various species of freshwater fish. The long-term toxicity and the effect of vanadium on the reproduction of a daphnid, Daphnia magna, was also evaluated and compared with the toxicity of other metals. It was found from the life-cycle test with Daphnia magna that vanadium induced mortality rather than impairment of reproduction and tests pointed to direct toxic action of vanadium rather than accumulation. Results of tests on fish indicated slow vanadium uptake and a delay in the expression of toxicity. (Wood-PTT)
W88-01717

EFFECTS OF SUPPLEMENTS ON THE BIOACCUMULATION OF LEAD IN ANABAENA SPP.,
Morehouse Coll., Atlanta, GA. Dept. of Biology.
J. Bender, and V. Ibeanusi.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 2, p 209-213, August 1987. 3 fig, 6 ref. U.S. Bureau of Mines Contract J0134023 and NIH Grant RR-8006.

Descriptors: *Water pollution effects, *Lead, *Algae, *Bioaccumulation, Cyanophyta, Anabaena, Carbon dioxide, Wastewater pollution, Wastewater, Heavy metals, Biomass, Energy, Light, Glucose, Microbiological studies.

A descriptive model of long-term metal uptake, including experiments in media enrichment, is lacking in previous research. Understanding the process of metal uptake and its relation to cell growth over longer periods of time is important to both the development of recovery systems and the provision of metal transport through the ecosystem. Therefore, the effects of carbon dioxide and wastewater enrichment on the simultaneous culture and lead uptake in Anabaena during a 30-day culture period, and the effects of energy supply on the lead uptake were investigated. It was found that the presence of carbon dioxide or wastewater supplements increased the lead uptake rate by Anabaena and that the two combined produced the highest level of lead uptake. Enrichment significantly increased lead uptake after 6 days, but there was a lack of correlation between biomass production and lead uptake. Carbon dioxide increased lead uptake but not culture growth between days 6 and 22. Analysis at the 26th day of culture showed that enrichments of both wastewater and carbon dioxide produced approximately a 100% increase in biomass with only a 28% increase in lead uptake. The requirement of energy for lead uptake was demonstrated. Light appeared to provide a better energy source than glucose; in glucose-supplemented cultures lead uptake seemed to compete with cell growth. (Wood-PTT)
W88-01718

EFFECTS OF THE PESTICIDE DIFLUBENZURON ON LARVAL HORSESHOE CRABS, LIMULUS POLYPHEMUS,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Biological Sciences.
J. S. Weis, and A. Ma.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 2, p 224-228, August 1987. 1 fig, 11 ref.

Descriptors: *Water pollution effects, *Pesticide toxicity, *Diflubenzuron, *Horseshoe crabs, *Larval growth stage, Pesticides, Insecticides, Crustaceans, Mortality, Lethal limit, Molting, Crabs.

Diflubenzuron (DFB), used for insect control, is a chitin synthesis inhibitor and, therefore, not a wide spectrum toxicant, but it does have adverse effects on important non-target organisms such as the crustaceans. Organisms inhabiting the intertidal zone and shallow estuarine areas would be expected to be those at most risk from runoff of sprayed DFB. The horseshoe crab, Limulus polyphemus, is a member of the estuarine community; adults breed on beaches, eggs are buried in the sand, and the larvae move into the water after hatching. Therefore, the effects of DFB on molting and mortality of the L. polyphemus larvae were investigated. It was found that the crabs in the 5 microgram DFB/liter group showed slight but significant delay at 14 days, but then molted at a rate comparable to the seawater controls; they exhibited no significant mortality. The crabs in the 50 microgram DFB/liter group, while molting at the same rate as the controls, exhibited severe mortality immediately after ecdysis. In addition, the prosomal width of the crabs in this group was smaller than that of the controls and that of the group in the 5 microgram DFB/liter. (Wood-PTT)
W88-01720

COMPARISON OF ETHANOL TOXICITY TO DAPHNIA MAGNA AND CERIODAPHNIA DUBIA TESTED AT TWO DIFFERENT TEMPERATURES: STATIC ACUTE TOXICITY TEST RESULTS,
Dow Chemical Co., Midland, MI. Health and Environmental Sciences.
I. T. Takahashi, U. M. Cowgill, and P. G. Murphy.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 2, p 229-236, August 1987. 6 tab, 15 ref.

Descriptors: *Water pollution effects, *Ethanol, *Crustaceans, *Toxicity, Solvents, Organic solvents, Daphnia magna, Daphnia, Ceriodaphnia dubia, Temperature, Mortality, Lethal limit.

Ethanol is a commonly used solvent in toxicity testing, but there are few studies in the literature devoted to its toxicity to zooplankton. The responses of Daphnia magna and Ceriodaphnia dubia to ethanol were investigated at temperatures chosen to match those used in toxicity testing, 20 and 24 C. No statistically significant difference by chi-square between the toxicity of ethanol to D. magna at 20 and 24 C was found, though C. dubia was significantly more sensitive to ethanol at 24 C than at 20 C. C. dubia was 1.9 times more sensitive to ethanol than D. magna at 20 C, and 2.4 times more sensitive to ethanol than D. magna at 24 C. The response differences are probably due to the vast difference in size; healthy D. magna neonates weigh approximately 18 micrograms dry, while healthy C. dubia neonates weigh about 4 micrograms dry. It was concluded that the requirement of <0.5 ml/L ethanol for D. magna will not create added problems in the execution of the static acute test, but it may prove detrimental to C. dubia at either temperature. (Wood-PTT)
W88-01721

SHORT-TERM EFFECTS OF PROPANIL ON OXYGEN PRODUCTION BY PLANKTON COMMUNITIES FROM CATFISH PONDS,
Delta Branch Experiment Station, Stoneville, MS.
C. S. Tucker.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 39, No. 2, p 245-250, August 1987. 1 fig, 1 tab, 6 ref. USDA Agreement 84-CSRS-2-2363.

Descriptors: *Agricultural runoff, *Water pollution effects, *Propanil, *Plankton, *Oxygen production, *Herbicides, Pesticides, Oxygen, Catfish, Chemical interference, Mississippi, Photosynthesis, Fish ponds, Fish population.

In Mississippi, the commercial pond culture of channel catfish Ictalurus punctatus often occurs in ponds adjacent to rice fields which are sprayed with the herbicide propanil. Because the pesticide is usually applied to the rice fields by airplane, the propanil could drift over the catfish ponds and cause depletion of dissolved oxygen in the ponds. The depletion was presumed caused by decreased photosynthetic oxygen by the pond phytoplankton community or by increased phytoplankton community respiration. Therefore, the short-term effects of propanil on net oxygen production by plankton communities from catfish ponds were investigated. It was found that propanil is a potent inhibitor of photosynthetic oxygen production; propanil concentrations from 24 to 54 micrograms/liter were estimated to cause a 25% reduction in oxygen production. Propanil concentrations up to 160 micrograms/liter did not affect oxygen consumption by communities significantly, so the decreases in net community oxygen production were caused by inhibition of photosynthetic oxygen production. The relative effect of propanil on oxygen production appeared to be independent of the general taxonomic composition of the phytoplankton community. (Wood-PTT)
W88-01723

PREFERENCE OF THE GREEN PEACH APHID, MYZUS PERSICAE, FOR PLANTS GROWN IN SEWAGE SLUDGES,
Cornell Univ., Ithaca, NY. Dept. of Entomology.
For primary bibliographic entry see Field 3C.
W88-01724

ASPECTS OF PHOSPHOGYPSUM WASTE DISPOSAL,
Steffen, Robertson and Kirsten, Inc., Vancouver (British Columbia).
For primary bibliographic entry see Field 5E.
W88-01733

LONG-TERM IMPACTS OF INDUSTRIAL WASTE CODISPOSAL IN LANDFILL SIMULATORS,
SCS Engineers, Inc., Covington, KY.
For primary bibliographic entry see Field 5E.
W88-01738

DYNAMICS OF BLUE-GREEN ALGAL (MICROCYSTIS AERUGINOSA) BLOOMS IN THE LOWER NEUSE RIVER, NORTH CAROLINA: CAUSATIVE FACTORS AND POTENTIAL CONTROLS,
North Carolina Univ. at Chapel Hill. Inst. of Marine Sciences.
H. W. Paerl.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 217162/AS. Price codes: A09 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Completion Report No. 229, April 1987. 164 p, 59 fig, 6 tab, 54 ref. Contract No. 14-08-0001-G1035. Project No. USGS G1035-07.

Descriptors: *Cyanophyta, *Eutrophication, *Nutrients, *Nitrogen, *Phosphorus, *Nutrient removal, Algal blooms, Water quality, Management,

Neuse River, North Carolina, Limiting nutrients, Water pollution effects, Water pollution control.

The physiological ecology of nuisance blue-green algal blooms is linked to environmental features of the lower Neuse River in North Carolina. Both field and laboratory monitoring efforts and experiments were carried out on a continuous basis from 1981 until 1986 in order to assess the linkage between periodicity and magnitudes of nutrient inputs (loading) as well as amenable physical conditions (water discharge, flow, temperature, irradiance) responsible for bloom development and persistence during hydrologically diverse years. Variable hydrological conditions, particularly evident as wet vs. dry spring-summer months, played a crucial role in determining bloom potentials in respective years. Both adequate nutrient (specifically nitrogen) loading during wet spring months as well as subsequent low discharge (low flushing) conditions in summer-fall months played joint roles in dictating the magnitudes and persistence of blooms. Nutrient addition bioassay techniques revealed that nitrogen, largely as NO3-, controlled both magnitudes of primary productivity and M. aeruginosa bloom development. In part, periodic nitrogen limitation is a product of very high phosphorus (as PO43-) loading, which leads to excessive (for phytoplankton growth) PO43- concentrations on a year-round basis. Through the use of a novel nutrient dilution technique, it was concluded that at least a 30% cutback in spring and summer inorganic nitrogen loading will be effective in stemming M. aeruginosa bloom potentials, even during a 'worst case' subsequent low discharge summer. Excessive phosphorus loadings should also be reduced by at least 50% as part of a long-term management strategy for the lower Neuse River. (Lambert-UNC, WRRI)
W88-01761

NUTRIENT ENRICHMENT OF THE CHESAPEAKE BAY,
Maryland Univ., Solomons. Chesapeake Biological Lab.
For primary bibliographic entry see Field 2L.
W88-01802

EFFECTS OF EXPOSURE TO PETROLEUM HYDROCARBONS ON THE GILL FUNCTIONS AND CILIARY ACTIVITIES OF A MARINE BIVALVE,
Malta Univ., Msida. Dept. of Mathematics and Science.
V. Axiak, and J. J. George.
Marine Biology MBIOAJ, Vol. 94, No. 2, p 241-249, March 1987. 9 fig, 4 tab, 14 ref.

Descriptors: *Hydrocarbons, *Petroleum products, *Oil pollution, *Water pollution effects, Oil, Mollusks, Clams, Physiological effects.

The effects of long-term exposure to low levels of water-accomodated fractions of Kuwait crude oil, or to short-term exposure to chemically dispersed oil, on the gill performance of the clam Venus verrucosa were investigated. Reduced pumping activities of the lateral cilia as well as interference with the normal beating activities of the eulaterofrontal cirri led to reduced clearance rates and retention efficiencies of food particles less than 6 micrometers in diameter. Frontal ciliary activities were significantly accelerated, while any retained oil droplets were conducted to the mouth region as food particles. The activities of terminal and sensory cilia were also enhanced, and mucus production increased. Such responses may lead to a reduced or negative energy budget by the clam. (Authors' abstract)
W88-01804

BAYESIAN ANALYSIS OR SCIENTIFIC JUDGMENT OF UNCERTAINTIES IN ESTIMATING RISK DUE TO RN-222 IN U.S. PUBLIC DRINKING WATER SUPPLIES,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5G.
W88-01810

ALIPHATIC AND AROMATIC HALOCARBONS AS POTENTIAL MUTAGENS IN DRINKING WATER. III. HALOGENATED ETHANES AND ETHENES,
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
K. Strobel, and T. Grummt.
Toxicological and Environmental Chemistry TXECBP, Vol. 15, Nos. 1/2, p 131-128, 1987. 1 fig, 4 tab, 117 ref.

Descriptors: *Chlorinated hydrocarbons, *Water quality control, *Drinking water, *Water treatment, *Water pollution effects, *Chlorination, Bioaccumulation, Industrial wastewater, Wastewater treatment, Water pollution sources, Halogens, Toxicity, Coolants, Disinfection.

Members of the groups of halogenated ethanes and ethenes (ethylenes) can either be formed during chlorination of drinking water or are of commercial importance and, therefore, produced in considerable amounts. Bromoethane (BEA), 1,2-dichloroethane (1,2-DCEA), 1,2-dibromoethane (1,2-DBEA), 1,1,1-trichloroethane (1,1,1-TCEA), 1,1,2-trichloroethane (1,1,2-TCEA), 1,1,1,2-tetrachloroethane (1,1,1,2-TCEA), 1,1,2,2-tetrachloroethane (1,1,2,2-TCEA), 1,1,2,2-tetrabromoethane (1,1,2,2-TBEA), 1,1-dichloroethene (1,1-DCE), 1,2-trans-dichloroethene (1,2-trans-DCE), 1,2-dibromoethene (1,2-DBE), and trichloroethene (TCE) have been tested for their mutagenic activity in the Ames test. The tester strains TA 97, TA 98, TA 100, and TA 104 were employed. All tested compounds induced mutagenic effects in at least two tester strains. With the exception of TCE all substances induced both base-pair substitutions and frameshift mutations. 1,1-DCE occurred as promutagen. The highest numbers of revertants were detected for 1 2-DCEA. The evidence of their presence in drinking water and their mutagenic activity makes them a potential health hazard. (Author's abstract)
W88-01811

OCCURRENCE OF PRECURSORS AND N-ALKYL-N-NITROSO COMPOUNDS,
National Swedish Environment Protection Board, Solna.
C. E. Bostrom, and L. E. Tammelin.
Journal of Environmental Pathology, Toxicology, and Oncology JEPOEC, Vol. 7, No. 4, p 109-112, 1987. 4 tab, 9 ref.

Descriptors: *Nitrates, *Nitrites, *Carcinogens, *Water pollution sources, *Water pollution effects, Foods, Fertilizers, Chemical reactions, Environmental effects, Fate of pollutants.

Nitrate, which is present in plants, soil, air, and water, may be considered a precursor of nitrosamines and nitrosamides. Increased use of fertilizers increases the nitrate concentrations in soil and fresh water sources. Microorganisms in human saliva reduce nitrate to nitrite. It has been estimated that 75% of the nitrite reaching the stomach in man originates from saliva, and 25% from cured meat products which contain nitrite. Certain reactions may decrease and in certain circumstances eliminate the risk due to nitrite. Generalizing from a number of experiments regarding the fate of nitrite in meat it has been found that myoglobin accounted for 5-15% of the nitrite originally added, nitrate 1-10%, gas 1-5%, sulfhydryl 5-15%, lipid 1-5%, and protein 20-30%. Maximum 80% and minimum 33% of the nitrite had reacted. It is, however, not certain that these reactions eliminate the risk of formation of N-nitroso compounds. In summary, precursors of N-nitroso compounds are present in food and saliva to such an extent that the elimination of the formation of N-nitroso compounds seems impossible. The possibilities of reducing precursor intake remain to be investigated. (Airone-PTT)
W88-01821

OIL CONTAMINATION OF RAPTORS MIGRATING ALONG THE RED SEA,
W. S. Clark, and E. Gorney.
Environmental Pollution EPEBD7, Vol. 46, No. 4, p 307-313, 1987. 1 tab, 9 ref.

Descriptors: *Oil pollution, *Water pollution effects, *Red Sea, *Raptors, *Migration, Birds, Asphalt, Elat, Israel, Oil spills.

There are few accounts of oil contamination of raptors, and it has not been considered a threat for them. However, oil-based asphalt was found on 55 individuals of 9 species out of 1052 raptors (5.2%) captured and examined in the spring of 1985 and 1986 during a raptor migration study at Elat, Israel. Some were extensively contaminated and probably succumbed to the effects of ingested asphalt. The birds most likely picked up the contamination while drinking water from pools with surface oil. Examples of the contamination are described. Over 1.2 million raptors were counted passing Elat during the spring of 1985. If 5% of these were contaminated, that would be over 60,000 birds, and this does not consider the raptors that migrate along the Red Sea and do not pass near Elat, nor those that pass Elat unseen by the counters. Thus asphalt contamination could be a major problem for raptors migrating along the Red Sea. (Author's abstract)
W88-01857

IMPACT OF ACIDIFICATION ON MACROINVERTEBRATE ASSEMBLAGES IN WELSH STREAMS: TOWARDS AN EMPIRICAL MODEL,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
N. S. Weatherley, and S. J. Ormerod.
Environmental Pollution EPEBD7, Vol. 46, No. 3, p 223-240, 1987. 2 fig, 9 tab, 45 ref.

Descriptors: *Macroinvertebrates, *Water pollution effects, *Wales, *Model studies, *Tywi River, *Acidic waters, *Acid rain, Water chemistry, Statistical analysis, Hydrogen ion concentration, Chemical analysis.

There is a need to predict the effects of possible future patterns of acid deposition on the biological components of fresh waters. A model was developed of the relationships between water chemistry and macroinvertebrate assemblages in eighteen streams in the upper Tywi River, Wales, whose catchments are subject to different land uses. Using established statistical techniques on data sets derived from riffle and margin samples taken in spring and summer, the macroinvertebrate assemblages were classified into three groups, which corresponded with streams draining conifer afforested catchments, acidic moorland streams and circumneutral moorland streams. Following principal components analysis to select key environmental variables, the application of multiple discriminant analysis generated two discriminant functions which were related most strongly to mean filterable aluminum concentration and mean total hardness, respectively. The discriminant functions were used to assign site-group membership with 100% success in the case of the spring data set with combined habitats. In addition, multiple regression of the primary ordination axis of each data set on mean aluminum concentration and mean hardness or pH, produced equations which explained 62.0%-87.2% of the variance. It is concluded that the methods used here provide an effective analytical and potentially predictive tool for use in the understanding and management of the impact of acidification on freshwater ecosystems. (Author's abstract)
W88-01865

DEVELOPMENT OF A MATHEMATICAL EUTROPHICATION MODEL OF THE LAGOON OF VENICE,
Venice Univ. (Italy). Dept. of Spectroscopy, Electrochemistry and Physical Chemistry.
For primary bibliographic entry see Field 5B.
W88-01873

EUTROPHICATION MODEL OF THE VENICE LAGOON: STATISTICAL TREATMENT OF 'IN SITU' MEASUREMENTS OF PHYTOPLANKTON GROWTH PARAMETERS,
Venice Univ. (Italy). Dept. of Spectroscopy, Elec-

trochemistry and Physical Chemistry.
M. Bertonati, C. Dejak, I. M. Lalatta, and G. Pecenik.
Ecological Modelling ECMODT, Vol. 37, Nos. 1/2, p 103-130, June 1987. 8 fig, 3 tab, 41 ref.

Descriptors: *Eutrophication, *Lagoons, *Venice, *Statistical analysis, *Phytoplankton, Biomass, Mathematical models, Eddy diffusion, Model studies.

A mathematical eutrophication model was obtained by combining a pre-existing three-dimensional model based on eddy-diffusive transport, embodying tidal agitation, and a 'trophic dynamic reactor' interconnecting eight intensive physicochemical and biological variables. Parameters included in the phytoplankton growth equation, K sub N, K sub p, mu sub max, were obtained through several 'in situ' investigations performed under varying lagoon conditions. The usual statistical treatments for analyzing collected data, combined with nonlinear multiple variability, were found unsuitable. Therefore, three statistical methods were elaborated: algebraic resolution, including analyses of normal and log-normal distributions of the results; multiple regression analyses with constrained minima through a secular equation of the sixth degree; and analysis of the hypersurfaces of variance and reconstruction, from computer maps, of three-dimensional profiles with paraboloid-like base. Comparisons of results obtained with these methods permit delimitation of variability ranges of constants. Further, the values adopted in the model to simulate trophic equilibria, reproduced real lagoon conditions. (Author's abstract)
W88-01878

ACID RAIN AFFECTS EGG-LAYING BEHAVIOR OF APPLE MAGGOT FLIES,
Massachusetts Univ., Amherst. Dept. of Entomology and Plant Pathology.
A. L. Averill, E. S. Bowdan, and R. J. Prokopy.
Experientia EXPEAM, Vo. 43, No. 8, p 939-942, 1987. 3 fig, 20 ref. DOA Grant No. 7800168.

Descriptors: *Acid rain, *Water pollution effects, *Ecological effects, *Insect behavior, *Apple maggot flies, *Eggs, Simulation analysis, Apples, Flies, Hydrogen ion concentration, Nitric acid, Sulfuric acid.

How acid precipitation affects insects and insect-plant interactions is poorly understood, although an increasing number of reports cite complex and varied impacts of acids on plant, water, and soil systems. During field tests, a perplexing variability in egg-laying behavior of the apple maggot fly, Rhagoletis pomonella (W.) (Diptera: Tephritidae) was observed, when presented with fruit that had been exposed to different rainfall events. In a series of experiments, the hypothesis that these observations could be explained by differences in the pH of natural rains was tested. A second experiment, evaluated the effect of simulated rain by 'acidifying' distilled water using a 3:2 molar ratio of sulfuric and nitric acids. Although acid precipitation is composed of a constellation of substances, these 2 acids are the primary components and this is the approximate ratio of these acids occurring in the Amherst, MA, area rainfall. It was found that the tephritid fruit fly is less likely to attempt ovipcsition in host fruit that have been exposed to acid rain or to a simulated acid rain solution (pH < 3.8). Electrophysiological data suggest that acid rain residue on the fruit surface may interfere with the sensory mechanisms that the fly uses during recognition and acceptance of host fruit. (Lantz-PTT)
W88-01879

TEAM STUDY: PERSONAL EXPOSURES TO TOXIC SUBSTANCES IN AIR, DRINKING WATER, AND BREATH OF 400 RESIDENTS OF NEW JERSEY, NORTH CAROLINA, AND NORTH DAKOTA,
Environmental Protection Agency, Washington, DC.
L. A. Wallace, E. D. Pellizzari, T. D. Hartwell, C. Sparacino, and R. Whitmore.
Environmental Research ENVRAL, Vol. 43, No. 2, p 290-307, August 1987. 2 fig, 7 tab, 23 ref.

Descriptors: *Water pollution effects, *Drinking water, *New Jersey, *North Carolina, *North Dakota, *Public health, *Chloroform, Organic compounds, Toxicity, Monitoring.

EPA's TEAM (Total Exposure Assessment Methodology) Study has measured exposures to 20 volatile organic compounds in personal air, outdoor air, drinking water, and breath of approximately 400 residents of New Jersey, North Carolina, and North Dakota. All residents were selected by a probability sampling scheme to represent 128,000 inhabitants of Elizabeth and Bayonne, New Jersey, 131,000 residents of Greensboro, North Carolina, and 7,000 residents of Devils Lake, North Dakota. Several hypotheses regarding indoor sources of volatiles have been generated, and some have been further investigated and partially confirmed. One such hypothesis is the use of hot water as the main source of airborne chloroform in homes. This hypothesis is based on the observation that the median indoor level of chloroform was four times the median outdoor level in New Jersey in the fall of 1981. Assuming a typical air exchange rate of 0.5 ach and a typical home volume of 300 cu m, a total of 150 micrograms of chloroform would have to be liberated each hour to achieve a steady-state concentration of 1 microgram/cu m above background (outdoor) levels. Assuming a concentration of 50 micrograms chloroform/L of water, at least 3 L/hr or approximately 70 L/day would be required to liberate all contained chloroform to achieve this indoor concentration. Common large-scale uses of hot water in most homes include baths or showers and washing clothes and dishes. Since this speculation was first made, a study has reported such liberation of volatile organics during showers. (Lantz-PTT)
W88-01881

PH-RESPONSE ON LEAVES AND ISOLATED CUTICLES OF HEDERA HELIX L. AFTER WETTING WITH ARTIFICIAL RAINWATER,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
O. Klemm, M. Riederer, and T. Frevert.
Environmental and Experimental Botany EEBODM, Vol. 27, No. 3, p 349-355, July 1987. 5 fig, 1 tab, 20 ref.

Descriptors: *Hydrogen ion concentration, *Hedera helix L., *Artificial rain, *Acid rain, *Water pollution effects, *Leaves, Plant tissues, Cuticles, English ivy, Chemical reactions, Buffers, Cation exchange.

pH measurements on leaves of Hedera helix L. indicate the amount and strength of acids present on the leaves, and the buffering mechanisms taking place. To measure the amount and strength of acids on dry leaves the leaf surfaces had to be wetted with water and the pH determined from at least two different wetting thicknesses. For strong acids delta pH/delta lg vol should be +0.95. pH microelectrode measurements on untreated leaves and isolated cuticles (the physiologically inner side was kept moist with a pH-buffer solution) indicated that no buffering action (e.g. by weak acids) takes place when acidic rainwater is evaporated from leaves. Thus, acidity of leaf surfaces of English ivy is only controlled by the evaporation rate of the precipitated rainwater. No strong acids can be found on leaves of field grown English ivy, collected in Northern Bavaria. Even under optimized conditions no buffering action by cation exchange through isolated cuticles could be observed. (Lantz-PTT)
W88-01885

TOXICOLOGY OF ORGANIC MICROPOLLUTANTS IN DRINKING WATER: ESTIMATING THE RISK,
Water Research Centre, Medmenham (England).
For primary bibliographic entry see Field 5G.
W88-01899

EPIDEMIOLOGICAL SURVEY OF A MAJOR OUTBREAK OF NOSOCOMIAL LEGIONELLOSIS,
Institut National de la Sante et de la Recherche Medicale, Paris (France).
M. Guiguet, J. Pierre, P. Brun, G. Berthelot, and S. Gottot.
International Journal of Epidemiology IJEPBF, Vol. 16, No. 3, p 466-471, 1987. 1 fig, 5 tab, 24 ref.

Descriptors: *Water pollution effects, *Nosocomial diseases, *Legionellosis, *Human diseases, *Water pollution sources, *Path of pollutants, Infection, Hospitals, Statistical analysis, Epidemiology, Public health, Multivariate analysis, Mathematical studies, Water pollution.

Forty-seven nosocomial cases of legionellosis due to Legionella pneumophila serogroup 1 were diagnosed in one major outbreak from November 1982 to March 1983 in a 960-bed teaching hospital. Contaminated water was considered to be a possible source of infection because, during that period, monthly samples were found to be positive with averages of 10,000 CFU/liter. After chlorination of hot water associated with flushing of outlets, nearly all samples taken in the next two years were found to be negative. A case-control study was performed to examine potential risk factors. Three groups of controls were randomly selected among eligible patients: malignant illness (relative risk, RR = 3.5), presence of an ultimately fatal disease (RR = 2.6), and exposure to corticosteroids prior to admission (RR = 7.9). Investigations of in-hospital exposures suggest that during this nosocomial outbreak, diagnostic or therapeutic respiratory procedures had not increased the risk of illness. Although the epidemiological association between water contamination and disease remains unclear, the eradication of L. pneumophila from the identified water supply was effective in preventing disease in the hospital. (Author's abstract)
W88-01920

WATERBORNE OUTBREAKS IN SWEDEN - CAUSES AND ETIOLOGY,
National Bacteriological Lab., Stockholm (Sweden).
Y. Andersson, and T. A. Stenstrom.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 575-580, 1987. 1 fig, 3 tab, 11 ref.

Descriptors: *Epidemics, *Public health, *Water pollution effects, *Wastewater pollution, Epidemiology, Sweden, Human diseases, Microbiological studies, Wastewater transport, Drinking water, Wastewater, Diseases.

Thirty-two waterborne outbreaks of disease in Sweden are known to have occurred during 1975 - 1984, affecting nearly 12,000 people. These range from single family outbreaks, to community outbreaks affecting up to 3,000 people. Microbial agents were isolated in about 40% of the outbreaks, the rest are of unknown etiology. Epidemiological investigations showed that only a fraction of the actual number of cases are initially reported. The real number, as judged from epidemiological follow-up investigations, was in many instances tenfold higher. In almost all the cases, the cause of the outbreaks was a technical deficiency like back-siphonage of wastewater along drainage pipes, broken sewerage or sudden pollution of raw water intakes coinciding with malfunction of chlorination. (Author's abstract)
W88-01951

PHOTOSYNTHETIC KINETICS DETERMINE THE OUTCOME OF COMPETITION FOR DISSOLVED INORGANIC CARBON BY FRESHWATER MICROALGAE: IMPLICATIONS FOR ACIDIFIED LAKES,
Queen's Univ., Kingston (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-01988

EFFECTS OF ARTIFICIAL ACID PRECIPITATION ON THE MYCORRHIZAS OF SCOTS PINE SEEDLINGS,
Institute of Terrestrial Ecology, Grange over Sands (England). Merlewood Research Station.

J. Dighton, and R. A. Skeffington.
New Phytologist NEPHAV, Vol. 107, No. 1, p 191-202, September 1987. 5 fig, 4 tab, 27 ref, append.

Descriptors: *Water pollution effects, *Acid rain, *Scots Pine, *Seedlings, Hydrogen ion concentration, Simulation analysis, Aluminum, Sulfates, Lysimeters.

Roots were examined from three-year-old Scots pine seedlings (Pinus sylvestris L.) growing on a humo-ferric podzol in monolith soil lysimeters which had received simulated acid rain at pH 3 or non-acidified rain. This is about 30 times the rate of wet H(+) deposition at the site from which the lysimeters were taken. Root biomass was similar between treatments, but acid-treated root systems showed significantly reduced fine root branching compared to the controls. The reduced branching of acid-treated root systems was attributed to a significant reduction in the occurrence of two coralloid mycorrhizal morphs. The coralloid mycorrhizas were characterized by profuse extramatrical hyphal development, the growth of which was retarded by soil conditions in the acid-treated lysimeters. Soil solution measurements showed the major effects of the acid treatment to be increases in concentrations of H(+), Ca(2+), Al and SO4(2-). It seems likely that an increase in Al and reduction of pH had affected the growth of these mycorrhizas. This may have nutritional consequences for trees on acidic soil. (Author's abstract)
W88-01991

DETECTION OF POLLUTION EFFECTS ON MARINE MACROBENTHOS: FURTHER EVALUATION OF THE SPECIES ABUNDANCE/BIOMASS METHOD,
Institute for Marine Environmental Research, Plymouth (England).
R. M. Warwick, T. H. Pearson, and Ruswahyuni.
Marine Biology MB10AJ, Vol. 95, No. 2, p 193-200, July 1987. 6 fig, 6 ref. Department of the Environment Contract No. PECD 7/1/179.

Descriptors: *Water pollution effects, *Marine environment, *Biomass, *Population dynamics, Data acquisition, Statistical analysis, Sensitivity analysis, Ecosystems, Ecological effects.

Empirical data are presented to evaluate the method of detecting pollution-induced disturbances in marine benthic communities by a comparison of the distribution of numbers of individuals among species with the distribution of biomass among species. A suggested abbreviated name for the technique is the ABC method (abundance biomass comparison). Application of the technique to new data shows that it is a sensitive indicator of natural physical and biological disturbance as well as pollution-induced disturbance over both spatial and temporal scales. Changes in the configuration of ABC plots during ecological succession are the reverse of those resulting from increased pollution levels. The technique should also be applicable to intertidal sediments, where physical disturbance of the sediment by waves does not appear to preclude its utility. (Author's abstract)
W88-01996

COLORECTAL CANCER MORTALITY AND INCIDENCE IN CAMPBELL COUNTY, KENTUCKY,
Northern Kentucky Univ., Highland Heights. Dept. of Biological Sciences.
R. E. Richmond, J. Rickabaugh, J. Huffman, and N. Epperly.
Southern Medical Journal SMJOAV, Vol. 80, No. 8, p 953-957, August 1987. 3 tab, 19 ref.

Descriptors: *Colorectal cancer, *Mortality, *Epidemiology, *Campbell County, *Kentucky, *Drinking water, *Water pollution effects, Public health, Statistical analysis, Water quality.

Previous publications have reported an unusually high colon cancer mortality rate for several Kentucky counties. These high rates were investigated by examining the incidence of colorectal cancer in one county with a high mortality rate. The objective was to determine whether the incidence of colorectal cancer was as high as mortality rates indicated and, if so, to look for possible etiologic factors for the high rates. The incidence of colon cancer was found to be significantly higher in Campbell County than expected; 162 cases of colon cancer were expected, 192 ($P < .01$) were actually observed. The number of rectal cancers was no higher than expected (52 expected and 62 observed), in agreement with previously reported mortality figures. A geographic plot of cases by home residence showed a significantly higher rate of colon cancer for urban county regions than for rural regions. In fact, the population of rural Campbell County had a colon cancer rate significantly lower than either the county rate or the national rate. Several factors were analyzed to explain these rate differences. The only consistently associated factor was source of residential drinking water. (Author's abstract)
W88-01999

EFFECT OF OIL AND DISPERSANTS ON THE GROWTH OF MUSSELS,
Trondheim Univ. (Norway). Museum.
T. Stromgren.
Marine Environmental Research MERSDW, Vol. 21, No. 4, p 239-246, 1987. 3 fig, 1 tab, 10 ref.

Descriptors: *Mussels, *Oil pollution, *Oil, *Dispersants, *Growth, *Water pollution effects, *Toxicity, Population exposure, Mixing, Mytilus.

Mussels (Mytilus edulis L.) were exposed to North Sea crude oil, microencapsulated oil and dispersants, singly and in combination, and growth rates measured at 24-48 h intervals. Exposure to microencapsulated pure oil (2.0-2.1 mg/L) and to microencapsulated mixtures of oil (2.2-2.5 mg/L) + 5% of the different dispersants (FINASOL OSR 5, COREXIT 9527, DISPOLENE 36 S) gave approximately the same reduction in growth rate (80-90%) within 170 h. Oil chemically dispersed with DISPOLENE 36 S and a pure oil mechanically dispersed in water were significantly less toxic. In high concentrations (2 mg/L) all dispersants are toxic, DISPOLENE 36 S significantly more than the others. Mussels exposed for 170 h to microencapsulated oil and to microencapsulated oil/dispersant mixtures recovered to control growth within 300 h in clean seawater, while in those given pure oil-in-water suspension, the recovery was slower. It is concluded that the toxicity of oil is mainly related to size and concentration of oil particles, while the effect of 5% dispersants added is negligible. (Author's abstract)
W88-02000

LONG-TERM (1978-1986) POPULATION TRENDS OF BLACK FIN AMPHIPODS OF PIERRE NOIRE (BAY OF MORLAIX, WESTERM ENGLISH CHANNEL) AFTER THE AMOCO CADIZ DISASTER (EVOLUTION A LONG TERME (1978-1986) DES POPULATIONS D'AMPHIPODES DES SABLES FINS DE LA PIERRE NOIRE (BAIE DE MORLAIX, MANCHE OCCIDENTALE) APRES LA CATASTROPHE DE L'AMOCO CADIZ,
Paris-6 Univ. (France).
J.-C. Dauvin.
Marine Environmental Research MERSDW, Vol. 21, No. 4, p 247-273, 1987. 7 fig, 6 tab, 35 ref.

Descriptors: *Oil pollution, *Oil spills, *English Channel, *Amoco Cadiz, *Amphipods, *Oil, *Water pollution effects, *Toxicity, Population exposure, Estuaries, Bays, Population dynamics.

Greatly reduced in 1978 by the Amoco Cadiz oil spill, the amphipod populations of the fine sand community of Pierre Noire in the Bay of Morlaix, have not yet fully recovered 8 years after the pollution. The sublittoral sandy-mud benthic communities in the western part of the English Channel show a discontinuous distribution, occurring in isolated zones which are localized in estuaries and bays. The amphipods, which are characteristic of these communities and lack a pelagic larva, form insular populations. This insular distribution delays their re-introduction to the fine sand community of Pierre Noire. Moreover, the biological and demographic characteristics of the species entail limited periods of recolonisation and increase in population. (Author's abstract)
W88-02001

EFFECTS OF ZINC SULPHATE ON HAEMATOLOGICAL PARAMETERS IN THE DOGFISH SCYLIORHINUS CANICULA AND INFLUENCES OF MS222,
Universidad Autonoma de Barcelona (Spain). Faculty of Sciences.
R. Flos, L. Tort, and J. Balasch.
Marine Environmental Research MERSDW, Vol. 21, No. 4, p 289-298, 1987. 4 tab, 35 ref.

Descriptors: *Dogfish, *Zinc, *Leucocyte, *Water pollution effects, *Toxicity, Population exposure, Anaesthetics, Hematology, Blood.

Haematological variables of dogfish collected in February and March were analyzed after treatment with acute and subacute zinc concentrations. Differences were found only in leucocyte number. Leucocyte levels were affected by time of analysis. The anaesthetic MS222 also exerted a significant influence on the white cell number. (Author's abstract)
W88-02002

BIOMPHALARIA GLABRATA (SAY), A SUITABLE ORGANISM FOR A BIOTEST,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 5A.
W88-02020

EFFECTS OF ATRAZINE ON DISSOLVED OXYGEN AND NITRATE CONCENTRATIONS IN AQUATIC SYSTEMS,
State Univ. of New York Coll. at Plattsburgh. Dept. of Biological Sciences.
P. M. Rocchio, and J. L. Malanchuk.
Environment International, Vol. 12, No. 6, p 597-601, 1986. 2 fig, 11 ref.

Descriptors: *Water pollution effects, *Atrazine, *Nitrates, *Dissolved oxygen, Aquatic habitats, Herbicides, Organic compounds.

The effects of the herbicide atrazine, on nitrate-nitrogen (nitrate-N) and dissolved oxygen concentrations in aquatic microcosms were determined. Treatment levels consisted of a control, 50, 100, and 150 microgram(ug)/L atrazine with four replicates per treatment. From a stock atrazine solution serial dilutions were prepared for each treatment level. The serial dilutions were added as single daily doses in 150 mL increments to the appropriate treatment. Dissolved oxygen was measured twice daily for each system. Nitrate-N concentrations were measured twice weekly for the duration of the experiment. Dissolved oxygen was not resistant to the atrazine perturbation and decreased to concentrations approximating 0.0 mg/L for all atrazine concentrations. However, dissolved oxygen concentrations were resilient to perturbation and recovered to pretreatment levels within 48 h following cessation of toxicant input. Nitrate-N concentrations also were not resistant to the atrazine perturbation and decreased to more than 90% of the pretreatment concentrations following atrazine introduction. Nitrate-N concentrations for atrazine treatments exhibited high resilience to the perturbation. Nitrate-N concentrations recovered to approximately 90% of the preperturbation nitrate-N concentrations 48 h after the cessation of the toxicant. Although small amounts of atrazine may have a significant impact upon aquatic systems by reducing levels of dissolved oxygen and nitrate, there appears to be no permanent ecosystem damage since these systems recover rapidly when atrazine levels return to zero. (Author's abstract)
W88-02022

DEVELOPMENT OF QUANTITATIVE ESTIMATES OF UNCERTAINTY IN ENVIRON-

MENTAL RISK ASSESSMENTS WHEN THE SCIENTIFIC DATA BASE IS INADEQUATE,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 7C.
W88-02025

THIOCYANATE TOXICITY TO DAPHNIA MAGNA: MODIFIED BY PH AND TEMPERATURE,
Concordia Univ., Loyola Campus, Montreal (Quebec). Ecotoxicology Research Lab.
S. J. Watson, and E. J. Maly.
Aquatic Toxicology AWTODG, Vol. 10, No. 1, p 1-8, April 1987. 3 fig, 2 tab, 25 ref.

Descriptors: *Toxicity, *Thiocyanates, *Daphnia, *Water pollution effects, Temperature effects, Hardness, Alkalinity, Effluents.

The toxicity of thiocyanate to Daphnia magna was investigated under different conditions of pH (5, 6 and 7) and temperature (8, 12 and 16 C). Water hardness was kept constant at 75 mg/L. Results indicate that at all pH levels an increase in temperature from 8 to 16 C increased toxicity. A rise in temperature from 8 to 16 C at pH 7 showed the greatest in toxicity (10-fold); at pH 5, a similar increase in temperature resulted in a 5.5-fold increase in toxicity. At all temperatures tested, an increase in pH from 5 to 7 decreased toxicity. The most toxic combination was found at pH 5 at 16 C. There are two main conclusions to be found based on these data. (1) The currently proposed standard for thiocyanate in effluent is too high to safely maintain D. magna populations. (2) The parameters used, pH and temperature, are important modifying factors of thiocyanate toxicity. (Author's abstract)
W88-02026

EFFECTS OF FEEDING AND TEMPERATURE ON UPTAKE, ELIMINATION AND METABOLISM OF BENZO(A)PYRENE IN THE BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS),
Tennessee Univ., Knoxville.
B. D. Jimenez, C. P. Cirmo, and J. F. McCarthy.
Aquatic Toxicology AWTODG, Vol. 10, No. 1, p 41-57, April 1987. 5 fig, 2 tab, 32 ref. DOE Contract DE-AC05-840R21400.

Descriptors: *Isotope studies, *Benzo(a)pyrene, *Water pollution effects, *Path of pollutants, *Bioaccumulation, *Bluegill, Population exposure, Food habits, Diets, Temperature, Fate of pollutants.

Bluegill sunfish (Lepomis macrochirus) were exposed to (14C)benzo(a)pyrene (BaP) in a flow-through system to examine the effects of temperature and feeding regime on BaP uptake and elimination and extent of biotransformation within the fish. The rate of uptake of BaP at 23 C was twice as fast in fish fed during aqueous exposure than in those denied food; however, the rate of elimination of radioactivity was 10 times greater in the fed fish. BaP was rapidly metabolized to polar and nonpolar metabolites, although 40 to 50% of the radioactivity in the fish appears to be covalently bound to cellular constituents. The rate of conversion of BaP to polar metabolites was also accelerated by feeding. Because animals in nature usually have food available, care must be exercised in using, applying, and extrapolating results of laboratory experiments in which food is withheld. Temperature is an environmental variable that had a significant effect on the uptake, elimination, and metabolic fate of organic contaminants. Both BaP uptake (5.8-fold) and 14C elimination rates (3.6-fold) at 13 C were lower than in fed fish exposed at 23 C. The metabolite profiles indicate that biotransformation of BaP is also much slower at the colder temperature. (Author's abstract)
W88-02027

EFFECT OF AVOIDANCE ON THE PLASMA-CATION CONCENTRATION OF BROOK TROUT (SALVELINUS FONTINALIS) SUBJECTED TO VARYING LEVELS OF ACIDITY,
Concordia Univ., Loyola Campus, Montreal (Quebec). Water Pollution Research Lab.
S. C. J. Pedder, and E. J. Maly.
Aquatic Toxicology AWTODG, Vol. 10, No. 1, p 29-39, April 1987. 4 fig, 2 tab, 48 ref.

Descriptors: *Water pollution effects, *Acid rain, *Trout, *Acid water, *Plasma, Fish behavior, Avoidance, Sodium, Potassium, Ions, Fish.

Groups of 20 juvenile brook trout (Salvelinus fontinalis) were subjected to sulfuric acid-treated waters (pH 4, 5, 5.5, and 6) over 96 h. Results showed a decrease in plasma-sodium levels as pH decreased, especially at pH 4. Plasma-calcium concentrations increased, as pH decreased to 5. Potassium levels decreased with increasing acid concentrations. Plasma magnesium decreased, but only slightly, when compared to the fluctuations of the other ions. The avoidance response of the test species to low pH was earlier reported with significant avoidance found below pH 5.5. Plasma-cation concentrations of test individuals indicate that lowest level without avoidance (pH 5.5) had greatest effect on ion regulation. Avoidance at the lowest acid level (pH 4) kept ion fluctuations minimal. (Author's abstract)
W88-02028

ANALYSIS OF ADDUCT FORMATION IN THE BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS) BETWEEN BENZO(A)PYRENE AND DNA OF THE LIVER AND HEMOGLOBIN OF THE ERYTHROCYTE,
Oak Ridge National Lab., TN. Engineering Technology Div.
L. Shugart, J. McCarthy, B. Jimenez, and J. Daniels.
Aquatic Toxicology AQTODG, Vol. 9, No. 6, p 319-325, February 1987. 1 fig, 1 tab, 24 ref. Martin Marietta Energy System, Inc. Contract DE-ACO5-840R21400.

Descriptors: *Benzo(a)pyrene, *Water pollution effects, *Path of pollutants, *Bioaccumulation, *Bluegill, Population exposure, Hemoglobin, DNA, Adducts, Temperature, Fish, Prediction.

Bluegill sunfish (Lepomis macrochirus) were exposed to a single dose of benzo(a)pyrene by i.p. injection and maintained at 13 or 20 C. Acid hydrolysis of DNA isolated from the liver and hemoglobin from the erythrocyte, 72-h posttreatment, released tetrols, which were separated and quantitated by high-performance liquid chromatography/fluorescence analysis. Examination of the tetrol profiles indicated that adduct formation with both macromolecules occurred via the anti- and syn-isomeric diol epoxide metabolites of benzo(a)pyrene. The majority of adducts in the DNA formed via the anti-diol epoxide (85%), which is similar to that reported for other organisms. However, adduct formation in hemoglobin was via both the anti- and syn-isomeric diol epoxides, which is different from that reported for mice. Furthermore, the amount of adduct formation in both macromolecules depended upon the temperatures at which the fish were maintained. Quantitation of the covalent interaction of genotoxic chemicals such as benzo(a)pyrene with cellular macromolecules can be a sensitive biological marker of early predictive value in assessing the significance of exposure to human health or ecosystem integrity. (Author's abstract)
W88-02030

INFLUENCE OF DIET AND PREEXPOSURE ON THE TOLERANCE OF SODIUM PENTACHLOROPHENATE BY RAINBOW TROUT (SALMO GAIRDNERI),
Waterloo Univ. (Ontario). Dept. of Biology.
B. E. Hickie, and D. G. Dixon.
Aquatic Toxicology AQTODG, Vol. 9, No. 6, p 343-353, February 1987. 1 fig, 4 tab, 37 ref. NSERC (Canada) Grant A8155.

Descriptors: *Toxicity, *Chlorinated hydrocarbons, *Pentachlorophend, *Water pollution effects, *Diets, *Population exposure, *Phenols, *Trout, *Liver, Enzymes, Sodium, Carbohydrates.

The combined effects of diets varying in carbohydrate-lipid ratio, as well as preexposure to sublethal levels of sodium pentachlorophenate (NaPCP), on the lethal tolerance of waterborne NaPCP by rainbow trout (Salmo gairdneri) were examined. The three diets used were practical salmonid formulations, equivalent in energy and protein content, with cerelose-fish oil ratios of 18.2:4.7% (high carbohydrate, HC) 9.3:9.1% (intermediate, INT), and 0.6:13.8% (low carbohydrate, LC). Trout that had been reared on the test diets for 12 wk, were exposed to 0 or 50 microgram(ug) NaPCP/L for the following 26 d. The incipient lethal level (ILL) of NaPCP for the three control groups (211 ug/L, LC;221 ug/L, INT; 224 ug/L, HC) and the NaPCP preexposed HC group (208 ug/L) were not significantly different. The ILL of NaPCP for the LC (182 ug/L) and INT (190 ug/L) NaPCP preexposed groups were significantly less than for the other groups, but not different from each other. Within each preexposure level, strong correlations were noted between the ILL of NaPCP and the diet-dependent parameters liver somatic index, liver glycogen content, liver protein content, and whole-body lipid content, Dietary lipid content appeared to be the primary feed component affecting the tolerance of NaPCP. (Author's abstract)
W88-02032

EVALUATION OF THE EFFECT OF CHEMICALS ON AQUATIC ECOSYSTEM BY OBSERVING THE PHOTOSYNTHETIC ACTIVITY OF A MACROPHYTE, PORPHYRA YEZOENSIS,
Tokyo Univ. of Fisheries (Japan). Dept. of Marine Environmental Science and Technology.
T. Yoshida, T. Maruyama, H. I. Kojima, I. Allahpichay, and S. Mori.
Aquatic Toxicology AQTODG, Vol. 9, No. 4,5, p 207-214, December 1986. 5 fig, 1 tab, 6 ref.

Descriptors: *Water pollution effects, *Photosynthesis, *Macrophytes, *Porphyra, *Bioindicators, Aquatic habitats, Isotope studies, Herbicides, Organic compounds, Chemicals.

Photosynthetic activity of a macrophyte, Porphyra yezoensis, was observed after exposure to chemicals in order to establish a method for evaluating their effects on the ecosystem. Both carbon assimilation and extracellular products were measured using (14C)Na2CO3. Commonly used herbicides, (1-(3,4-dichlorophenyl)-3,3-dimethylurea (DCMU), pentachlorophenol (PCP) and 3-amino-1H-1,2,4-triazol (amitrole), were tested. photosynthesis was inhibited by DCMU and PCP, and EC50 values were estimated to be 0.009-0.014 and 5.4-5.5 ppm, respectively. However, no significant inhibitory effect was observed with amitrole. Extracellular products showed an exponential increase in the cases of DCMU and PCP, similar to that observed in photosynthesis. Thus, the inhibitory effects of chemicals on the photosynthetic activity of Porphyra can be quantitatively observed using this method. (Author's abstract)
W88-02033

VERTEBRAL DEFORMITIES AND PHYSIOLOGICAL EFFECTS IN FOURHORN SCULPIN (MYOXOCEPHALUS QUADRICORNIS) AFTER LONG-TERM EXPOSURE TO A SIMULATED HEAVY METAL-CONTAINING EFFLUENT,
National Swedish Environment Protection Board, Nykoeping. Brackish Water Toxicology Lab.
B.-E. Bengtsson, and A. Larsson.
Aquatic Toxicology AQTODG, Vol. 9, No. 4,5, p 215-229, December 1986. 2 fig, 6 tab, 45 ref.

Descriptors: *Fish pathology, *Sculpin, *Water pollution effects, *Heavy metals, Effluents, Smelters, Population exposure, Fish, Industrial wastewater, Sulfides.

Fourhorn sculpin (Myoxocephalus quadricornis) were exposed for one year to two concentrations (0.1 and 1 vol %) of an artificial heavy metal-containing effluent from a sulfide ore smelter. At the end of the experiment, the fish were examined for alterations in vertebral structures, for otolith asymmetry and for physiological disturbances. Fourhorn sculpin exposed to the effluent displayed

'black tail', spinal curvature and increased frequency of vertebral deformities, particularly in the tail region. Comparison of weight differences between right and left otoliths revealed increased weight asymmetry among exposed fish. The effluent also caused a dose-dependent elevation of the ascorbic acid content in the liver and a strong inhibition of the enzyme delta-aminolevulinic acid dehydratase in the red blood cells. In addition, the effluent gave rise to an increased plasma potassium level and a decreased plasma chloride level. These physiological alterations indicate that the complex metal-containing effluent has profound effects on metabolic processes and ion balance. The results also confirm effects previously shown in field studies on fish living in the vicinity of the sulfide ore smelter. (Author's abstract)
W88-02034

INCREASED HEPATIC METALLOTHIONEIN CONTENT CORRELATES TO CADMIUM ACCUMULATION IN ENVIRONMENTALLY EXPOSED PERCH (PERCA FLUVIATILIS),
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
For primary bibliographic entry see Field 5B.
W88-02035

EFFECTS OF 2,4-D TREATMENT ON NATURAL BENTHIC MACROINVERTEBRATE COMMUNITIES IN REPLICATE ARTIFICIAL PONDS,
Guelph Univ. (Ontario). Dept. of Zoology.
M. Stephenson, and G. L. Mackie.
Aquatic Toxicology AQTODG, Vol. 9, No. 4,5, p 243-251, December 1986. 2 fig, 1 tab, 29 ref. Environment Canada Grant RA-0-5.

Descriptors: *Water pollution effects, *Ponds, *Herbicides, *Macroinvertebrates, Species diversity, Taxonomy, Population exposure, Organic compounds.

The impact of 2,4-dichlorophenoxyacetic acid (2,4-D) (applied at 1 mg 2,4-D/L an aquatic herbicide) on the natural macrobenthic community in artificial pond ecosystems was evaluated in 6 identical ponds planted with Eurasian water milfoil (Myriophyllum spicatum). Four ponds were treated with 2,4-D, 2 receiving the N,N-dimethylamine salt, and 2 the butoxyethyl ester. The benthic macroinvertebrate communities showed no primary effects due to treatment. Secondary effects appeared over a period of months, and by 338 days after treatment the diversity in treated ponds was significantly ($P < 0.05$) lower than the diversity in control ponds. Treated ponds were numerically dominated by Tubificidae, while several genera of Chironomidae, Gastropoda, and Tubificidae were numerically codominant in the control ponds. (Author's abstract)
W88-02036

USE OF BIOASSAYS TO ASSESS AQUATIC ARTHROPOD MORTALITY FROM PERMETHRIN DRIFT DEPOSITS,
Forest Pest Management Inst., Sault Sainte Marie (Ontario).
B. V. Helson, P. D. Kingsbury, and P. De Groot.
Aquatic Toxicology AQTODG, Vol. 9, No. 4,5, p 253-262, December 1986. 1 fig, 4 tab, 24 ref.

Descriptors: *Bioassay, *Arthropods, *Water pollution effects, *Toxicity, *Permethrin, Drift deposits, Mortality, Insecticides, Insects.

Three bioassay methods with 2 aquatic arthropods, Gammarus pseudolimnaeus (Crustacea: Amphipoda) and Aedes aegypti larvae (Insecta: Diptera), in artificial aquatic habitats were used to assess the acute lethal effects of permethrin due to downwind drift deposits from mistblower applications. In 3 separate tests, all methods produced similar results, namely, that single line sprays of permethrin at 35 g AI/ha resulted in mortality only within 30 m of the insecticide source. An application of 17.5 g AI/ha produced proportionately lower mortality. Mortality of amphipods was generally higher than that of mosquito larvae. The bioassay methods were very sensitive. Standards conducted concurrently with the tests gave LC50 values of 0.25-0.37 ppb for G. pseudolimnaeus and 0.69-1.85 ppb for A. aegypti larvae. (Author's abstract)
W88-02037

ACUTE TOXICITY OF POTASSIUM PERMANGANATE TO CHANNEL CATFISH FINGERLINGS,
Delta Branch Experiment Station, Stoneville, MS.
C. S. Tucker.
Aquaculture AQCLAL, Vol. 60, No. 2, p 93-98, February 1987. 3 fig, 10 ref. USDA Agreement 84-CSRS-2-2363.

Descriptors: *Potassium permanganate, *Water pollution effects, *Catfish, Oxygen demand, Population exposure, Fish, Growth stages, Inorganic compounds.

The 96-h LC50 of potassium permanganate ($KMnO_4$) applied as a single dose to fingerling channel catfish Ictalurus punctatus in aquaria increased from 4.5 to 17.6 mg/L as the chemical oxygen demand (COD) of the test waters increased from 21 to 118 mg/L. When the total amount of added $KMnO_4$ was divided into four equal doses applied at 30-min intervals, the 96-h LC50s ranged from 9.0 to 25.6 mg/L within a similar range of COD values. Relationships were also developed for the '15-min $KMnO_4$ demand' of the water, and COD values with the 96-h LC50 of $KMnO_4$. The 15-min $KMnO_4$ demand was found to be a relatively reliable predictor of $KMnO_4$ toxicity. (Author's abstract)
W88-02038

COMPARATIVE TOXICITY, CHOLINERGIC EFFECTS, AND TISSUE LEVELS OF S,S,S,-TRI-N-BUTYL PHOSPHOROTRITHIOATE (DEF) TO CHANNEL CATFISH (ICTALURUS PUNCTATUS) AND BLUE CRABS (CALLINECTES SAPIDUS),
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
C. Habig, R. T. Digiulio, A. A. Nomeir, and M. B. Abou-Donia.
Aquatic Toxicology AQTODG, Vol. 9, No. 5/6, p 193-206, December 1986. 6 fig, 33 ref. National Toxicology Training Program Grant 32ES 07031.

Descriptors: *Organophosphorus, *Phosphothioate, *Path of pollutants, *Water pollution effects, *Catfish, *Crabs, *Neurotoxicity, Toxicity, Enzymes, Fish, Tissue analysis.

The acute neurotoxic effects of S,S,S,-tri-n-butyl phosphorotrithioate (DEF) on juvenile channel catfish and adult blue craps was examined using short-term exposures in aerated, static aquaria. The effects on acetylcholinesterase (AChE) activity in catfish brain and skeletal muscle, and in crab ganglia, was studied. In addition, recovery of AChE activity was followed after transferring the animals to DEF-free water. The results indicate that both species exhibit pronounced anticholinesterase effects due to DEF. Recovery of AChE activity is quite slow in nervous tissues of both animals and catfish skeletal muscle, with effects persisting for several weeks following a single acute exposure. Tissue levels of DEF, as well as its rate of disappearance, were followed in several tissues of each species. The highest levels were detected in fish liver, but high levels were also detected in fish brain. Levels in crab ganglia were an order of magnitude lower than those in fish brain, but the anticholinergic effects were similar in both species. Disappearance was biphasic from tissues in both animals, with relatively long half-lives in target tissues. (Author's abstract)
W88-02040

ACUTE NITRITE TOXICITY AND METHEMOGLOBINEMIA IN JUVENILE MILKFISH (CHANOS CHANOS FORSSKAL),
Southeast Asian Fisheries Development Center, Iloilo (Philippines).
J. M. E. Almendras.
Aquaculture AQCLAL, Vol. 61, No. 1, p 33-40, March 1987. 4 fig, 1 tab, 19 ref.

Descriptors: *Water pollution effects, *Nitrites, *Toxicity, *Milkfish, Brackish water, Methemoglobin, Tissue analysis, Fish physiology, Fish, Growth stages, Population exposure.

Nitrite was about 55 times more toxic to milkfish juveniles in fresh water than in 1.6% brackish water: the 48-h median lethal concentrations were 12 mgNO_2-N/L (95% confidence limit = 7.4-19.6) and 675 mg NO_2-N/L (95% confidence limit = 435.8-1,045.4) respectively. Methemoglobin levels were higher for a given concentration of nitrite milkfish kept in fresh water than in the brackish water. Methemoglobin decreased to a normal level within 24-26 hours of the removal of nitrite. (Author's abstract)
W88-02042

BACTERIAL MUTAGENICITY AND CHEMICAL ANALYSIS OF POLYCYCLIC AROMATIC HYDROCARBONS AND SOME NITRO DERIVATIVES IN ENVIRONMENTAL SAMPLES COLLECTED IN WEST GERMANY,
York Univ. (England). Cancer Research Unit.
R. C. Garner, C. A. Stanton, C. N. Martin, F. L. Chow, and W. Thomas.
Environmental Mutagenesis ENMUDM, Vol. 8, No. 1, p 109-117, 1986. 3 fig, 3 tab, 30 ref.

Descriptors: *Water pollution effects, *Air pollution effects, *Mutagenicity, *Polycyclic aromatic hydrocarbons, West Germany, *Snow, *Pollutant identification, Sample preparation, Enzymes.

Snow and air particulate samples collected in Upper Frankonia, Federal Republic of Germany, have been analyzed for nitro-polycyclic aromatic hydrocarbons (PAH) and PAH content. A novel clean-up technique has been developed enabling interfering organochlorine environmental contaminants to be removed prior to analysis of the hydrocarbons by GC-MS. Mass fragmentation patterns are presented for 1-nitropyrene, 6-nitrobenzo(a)pyrene, 6-nitrochrysene, and 3-nitrofluoranthene. The level of these compounds found in air samples was in the range of 0.2-2.0 ng/cu m with the exception of 6-nitrobenzo(a)pyrene, which was not detected. This compares with PAH values of between 1 and 6 ng/cu m. The freshly fallen snow sample collected at the side of a motorway had no detectable PAHs or nitro-PAHs. Parallel studies on the bacterial mutagenicity of the collected air samples using Salmonella typhimurium TA98 and TA100 in the presence and absence of aroclor-induced rat liver 'S9' revealed both 'direct' and 'indirect' activity. Larger numbers of mutants were induced in the presence of S9 than in its absence. The snow sample was devoid of mutagenic activity. These studies show the utility of the biological approach to screen environmental samples prior to expensive and time-consuming chemical analysis. (Author's abstract)
W88-02057

MUTAGENICITY STUDIES IN SALMONELLA: RESIDUES OF OZONATED AND/OR CHLORINATED WATER FULVIC ACIDS,
Environmental Health Directorate, Ottawa (Ontario).
D. J. Kowbel, S. Ramaswamy, M. Malaiyandi, and E. R. Nestmann.
Environmental Mutagenesis ENMUDM, Vol. 8, No. 2, p 253-262, 1986. 2 fig, 2 tab, 41 ref.

Descriptors: *Ozonation, *Chlorination, *Water pollution effects, *Mutagenicity, *Wastewater treatment, *Disinfection, *Salmonella, Fulvic acids, Water pollution sources, Drinking water, Organic compounds.

Aqueous residues of ozonated, chlorinated, and ozonated/chlorinated water fulvic acids (WFA) were tested for induction of His(+) reversion in Salmonella typhimurium strain TA100 in fluctuation tests for mutagenicity. The data suggest that ozonation of natural organics present in sources of drinking water can prevent subsequent formation of by-products of chlorination that are mutagenic in bacteria. Ozonation of the WFA at different pH and at varying dose levels produced residues that were not or were only weakly mutagenic. Chlorination of WFA or of previously ozonated WFA led

to residues that were highly mutagenic. However, mutagen formation in the ozonated/chlorinated residues could be prevented, depending upon the pH of the WFA solutions during ozonation - mutagenicity decreased as pH increased. This decrease in mutagenicity is associated with previous observations of enhanced ozone decomposition into its highly reactive oxidant species at higher pH. Since ozonation seems to be more effective at alkaline pH, alkaline raw water sources seem to be the best candidates for water treatment that involves ozonation. (Author's abstract)
W88-02058

IN VITRO INDUCTION OF SISTER CHROMATID EXCHANGES AND CHROMOSOMAL ABERRATIONS IN PERIPHERAL LYMPHOCYTES OF THE OYSTER TOADFISH AND AMERICAN EEL,
North Carolina Univ., Morehead City. Inst. of Marine Sciences.
T. J. Ellingham, E. A. Christensen, and M. B. Maddock.
Environmental Mutagenesis ENMUDM, Vol. 8, No. 4, p 555-569, 1986. 2 fig, 3 tab, 46 ref. EPA R811134.

Descriptors: *Clastogens, *Water pollution effects, *Eels, *Toadfish, *Chromosomes, *Toxicity, Cytogenicity, Chromatid exchange, Mammals.

A series of experiments was conducted to characterize the proliferation of oyster toadfish lymphocytes in medium containing 5-bromodeoxyuridine (BrdUrd) and to determine the effectiveness of cytogenetic endpoints for assessing the genotoxic effects of in vitro exposure of toadfish and eel lymphocytes to known mammalian clastogens. Although the rate of proliferation of toadfish lymphocytes was low compared to that of mammalian lymphocytes, the effects of increasing BrdUrd concentrations were similar, in that proliferation exhibited a concentration-dependent inhibition for concentrations above 10 micromolar BrdUrd. Mitomycin C (MMC) and ethylene dibromide (EDB) induced concentration-dependent increases in chromatid-type exchange and SCE frequencies with least effective concentrations for SCE induction by that were comparable to or slightly lower than those that have been obtained with mammalian in vitro systems. In vitro exposure of toadfish lymphocytes to dimethoate (DIM) induced a concentration-dependent increase in SCE frequency that was much higher than that observed with mammalian in vitro systems. In vitro exposure of American eel lymphocytes to MMC also induced a concentration-dependent increase in the frequency of chromosomal aberrations and SCEs. These results indicate that cytogenetic endpoints can be effectively scored with cultured lymphocytes from these and perhaps other fish species with comparable karyotypes that contain an average of at least 0.07 pg DNA/chromosome. (Author's abstract)
W88-02059

CULTURE OF ENDOMYCES FIBULIGER IN MUSSEL PROCESSING WASTES AND PRECIPITATION WITH PEGS OF ITS EXTRACELLULAR AMYLOLYTIC SYSTEM,
Instituto de Investigaciones Pesqueras de Vigo (Spain).
M. Gonzalez, J. Miron, and M. A. Murado.
Biotechnology Letters BILED3, Vol. 9, No. 4, p 281-286, April 1987. 2 fig, 2 tab, 15 ref.

Descriptors: *Aquaculture, *Mussels, *Yeasts, *Growth, Culturing techniques, Water pollution effects, Wastewater, Nutrients, Starches, Chemical precipitation.

The growth of the yeast Endomyces fibuliger in mussel processing wastes and in a conventional medium with starch as C source is compared. The differences found mainly affect the levels of its extracellular amylolytic system. Precipitation of this system in several ways has permitted the definition of a method of improving the yields of the most usual ones. (Author's abstract)
W88-02060

EFFECT OF FERTILIZER, CHICKEN MANURE AND DAIRY MANURE ON TIMOTHY YIELD, TISSUE COMPOSITION AND SOIL FERTILITY,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Renewable Resources.
For primary bibliographic entry see Field 5E.
W88-02075

BIOMASS AND SPECIES RICHNESS OF AQUATIC MACROPHYTES IN FOUR MAINE (U.S.A.) LAKES OF DIFFERENT ACIDITY,
Maine Univ. at Orono. Dept. of Wildlife.
M. L. Hunter, J. J. Jones, J. W. Witham, and T. M. Mingo.
Aquatic Botany AQBODS, Vol. 24, No. 1, p 91-95, March 1986. 2 tab, 9 ref.

Descriptors: *Acid rain, *Biomass, *Species diversity, *Population density, *Maine, *Oligotrophic lakes, *Acidity, *Macrophytes, *Aquatic plants, Chemical properties, Density, Lakes, Headwaters, Ecology, Surveys.

Macrophyte communities of two pairs of oligotrophic headwater lakes of different acidity in Maine are described. In each pair, the lakes were physically similar, but differed chemically. Macrophytes were sampled in late July. Diversity was estimated by the Shannon index. Of 22 species of macrophyte recorded, all were found in the circumneutral lakes (14 and 15 each). The two acidic lakes had only 11 species (10 and 6 each). There was tremendous variation in the relative abundance of different species, with Eriocaulon septangulare dominating all four lakes. Biomass in the circumneutral lakes ranged from 14.0 to 157.86 g/sq m; values for the acidic lakes were intermediate (33.8 and 74.6 g/sq m). Previous studies had indicated that a shift of primary producers from the pelagic to the benthic zone may be a general consequence of lake acidification; these data show that this is not always the case. It is concluded that more surveys are needed. (Author's abstract)
W88-02079

INFLUENCE OF ACID PRECIPITATION ON THE DEVELOPMENT OF ERYSIPHE GRAMINIS DC F. SP. TRITICI MARCHAL (EINFLUSS SAEUREHALTIGER NIEDERSCHLAEGE AUF DIE ENTWICKLUNG VON ERYSIPHE GRAMINIS DC. F. SP. MARCHAL),
Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Mikrobiologie.
G. Koennecker, H. J. Aust, and H. J. Jaeger.
Zeitschrift fuer Pflanzenkrankheiten und Pflanzenschutz, Vol. 94, No. 1, p 58-67, February 1987. 6 fig, 1 tab, 26 ref.

Descriptors: *Acid rain effects, *Water pollution effects, *Acid rain, *Mildews, *Plant diseases, *Air pollution effects, *Fungi, Wheat, Parasites.

Plants of spring wheat cv. 'Kolibri' were inoculated with Erysiphe graminis f. sp. tritici and exposed to simulated acidic precipitation (H_2SO_4, HNO_3) of pH 3.0, 4.2, and deionized water (pH 5.6). Artificial rain of pH 3.0 significantly inhibited mildew development when plants were treated immediately after inoculation. Two different effects were observed: (1) non-germinated conidia were washed off by striking droplets, and (2) the effect of acidity. The pathogen was affected during the first 2 h and was most sensitive immediately after inoculation. Inhibitory effects rapidly decreased with further development of the fungus. Conidia taken from colonies exposed to acid precipitation were as infectious as conidia taken from untreated colonies. Acid rain had no predisposing effect on the leaf tissue as a substrate for germinating conidia. (Author's abstract)
W88-02098

USE OF AUTOCORRELATION MOLECULAR DESCRIPTORS IN QUANTITATIVE STRUCTURE-ECOTOXICITY RELATIOSHIPS STUDIES (UTILISATION DES DESCRIPTEURS MOLECULAIRES D'AUTOCORRELATION DANS LES ETUDES QUANTITATIVES DU TYPE STRUCTURE-ECOTOXICITE),
Institut Pasteur de Lyon (France). Lab. of Applied Hygiene.
J. Devillers, D. Zakarya, P. Chambon, and M. Chastrette.
Comptes Rendus de l'Academie des Sciences (Series 3) CHDDAT , Vol. 304, No. 9, p 195-198, March 1987. 1 fig, 1 tab, 20 ref.

Descriptors: *QSAR, *Water pollution effects, *Model studies, *Toxicity, *Aromatic hydrocarbons, Physico-chemical properties, Bonding, Molecular structure, Mathematical analysis, Data interpretation.

Autocorrelation molecular descriptors have been used for the description of toxicity (60 hrs., IC50) of 48 pollutants towards an holotrich ciliate protozoan, Tetrahymena pyriformis. The ecotoxicological significance of the model obtained is discussed and some remarks are made concerning improvement of the autocorrelation method. (Author's abstract)
W88-02104

GROUNDWATER IMPACTS FROM WASTEWATER LAND DISPOSAL SYSTEMS IN WISCONSIN,
Wisconsin Dept. of Natural Resources, Madison.
M. D. Witt, and D. K. Sauer.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 183-190, 8 tab, 11 ref.

Descriptors: *Land disposal, *Groundwater pollution, *Wisconsin, *Wastewater treatment, Groundwater quality, Dissolved solids, Chlorides, Alkalinity, Hardness, Biological oxygen demand, Nitrogen, Ammonia, Nitrates, Hydrogen ion concentration, Chemical analysis.

Seven wastewater land disposal systems in Wisconsin were evaluated as to their impact on the groundwater. The findings are summarized as follows: (1) Each of the seven systems have had some effect on the groundwater. The parameter which was elevated in each case was total dissolved solids (TDS). Concentrations of TDS in the downgradient wells ranged from 300 to 3,500 mg/L, while upgradient well TDS concentrations ranged from 200 to 1,000 mg/L. Lower TDS concentrations were found in sandy soils and sites which had lower hydraulic application rates; (2) Chloride concentrations in the wells were also elevated to almost 400 mg/L at those sites which had a significant source of chlorides in the wastewater; (3) Hardness and alkalinity concentrations were significantly elevated only at Site 3. Hardness was elevated from a background mean of 727 mg/L to a downgradient mean of 1,650 mg/L. Alkalinity concentrations increased from a background mean of 1,429 mg/L to a downgradient concentration of 2,178 mg/L; (4) Elevated concentrations of BOD5 or COD were not common in any of the seven sites; (5) Three of the seven sites had some increases of organic and ammonia nitrogen in the groundwater. Site 1 which has been identified before as being a grossly overloaded absorption pond had ammonia nitrogen concentrations of 50 mg/L and organic nitrogen concentrations of 26 mg/L in the groundwater monitoring wells. Site 2 had some increases of organic and ammonia nitrogen concentrations ranging from 4 to 13 mg/L; (6) Nitrate nitrogen concentrations in the groundwater were elevated to varying degrees at Sites 3, 4, and 7. Due to increased nitrate concentrations in the background wells at Sites 4 and 7, the exact contribution of nitrates to the groundwater was difficult to determine. At all three sites, however, the applied nitrogen in the wastewater was converted from the organic and ammonia forms to the nitrate form by the relatively permeable soils; and (7) Groundwater pH concentrations for six of the seven sites did not vary more than 0.8 units. This is due to the large buffering capacity which most soils have and the almost neutral pH of the wastewater. Site 7, however, showed some signs that the pH of the groundwater was dropping. Since the pH of the wastewater was approximately 4.0 to 4.5, the need for corrective action was apparent. (See also W88-02132) (Lantz-PTT)

W88-02152

WASTEWATER TREATMENT BY SPRAY IRRIGATION, QUALITY OF EFFLUENT AND IMPACTS ON SOILS AND GROUNDWATER,
Donohue and Associates, Inc., Sheboygan, WI.
For primary bibliographic entry see Field 5D.
W88-02153

COMPARISON OF ACUTE TOXICITY EVALUATIONS AND EPA WATER QUALITY CRITERIA WITH MACROINVERTEBRATE COMMUNITY ANALYSIS AT SITES OF ELECTRO-FINISHING DISCHARGES TO STREAMS,
Massachusetts Dept. of Environmental Quality Engineering, Westborough. Div. of Water Pollution Control.
For primary bibliographic entry see Field 5A.
W88-02192

CHANGING ILLINOIS RIVER,
Illinois Univ. at Urbana-Champaign. Water Resources Center.
G. E. Stout.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 171-177, 1 fig, 2 ref.

Descriptors: *Illinois River, *Environmental effects, *River basin development, Water resources development, Boats, Transportation, Municipal wastes, Industrial wastes, Water pollution control, Sediment transport, Sedimentation, Dissolved oxygen.

Largest of the Mississippi River's tributaries in North America above the mouth of the Missouri River, the Illinois River is formed by the confluence of the Kankakee and Des Plaines Rivers about midway between Chicago and LaSalle. The river flows in a westerly, southwesterly, and southerly direction for a distance of 340 km and empties into the Mississippi River at Grafton, Illinois. Little concern was shown about changes in, or the changing of, the Illinois River for the first 250 years of its use by white people. Steamboats made their way far up its reaches in the 19th century. Cities sprang up along its shores and, near the headwaters, Chicago began its growth. Events happened rapidly from the last quarter of the 19th century to the present time. Following the diversion of water from Lake Michigan into the Illinois in 1900, the construction of levees and the drainage of bottom lands for agricultural purposes began to change the nature of the Illinois valley. At the same time the aquatic biota ecosystem was threatened by the serious menace of the urban wastes and soil from erosion being discharged into the river. A decline in urban and industrial pollution began with the operation of treatment plants by the Chicago Sanitary District in 1922. Pollution control was aided by the navigation dams that become operational in the upper river in 1933. These dams reduced the rate of flow, thereby resulting in bacterial decomposition of waste products within a shorter distance downstream. A gradual reduction in the urban pollution of the Illinois river has continued to the present time. Nevertheless, between 1920 and 1960, major losses of fisheries occurred for reasons not completely understood. Yesteryear problems were much greater and more obvious than those which persist today. However, major problems do not presently exist throughout long reaches of the waterway. Basically, these problems are: (1) sediment transport and sediment deposition, and (2) low DO concentrations during warm low flow periods. Currently, costly programs to reduce nonpoint pollution from urban and agricultural sources are in effect in order to restore the ecosystem for aquatic organism. Eventually, body contact sports and sport and commercial fisheries will again become a benefit to the citizens of the region. (See also W88-02227) (Lantz-PTT)
W88-02244

1985 ANNUAL REPORT, COMMITTEE ON THE ASSESMENT OF HUMAN HEALTH EFFECTS OF GREAT LAKES WATER QUALITY.
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Science Advisory Board.
Revision of October 1986, Windsor, Ontario. 111 p, 7 tab, 11 append.

Descriptors: *Water pollution effects, *Great Lakes, *Public health, *Water quality, Chemical analysis, Data collections, Toxicity, Lethal limits, Fish, Carcinogens, Environmental effects.

Since its inception, the Committee on Human Health Effects of Great Lakes Water Quality has considered the possible health effects of chemical contamination in the Great Lakes. Past Annual Reports have summarized toxicity information of chemicals of concern listed in Appendix E to the 1978 Report of the Water Quality Board. In this report, the Committee summarizes available information on maximum allowable exposures for some of these chemicals and highlights possible issues of concern in the Great Lakes basin for further review and possible action by the jurisdictions. The recommendations for maximum tolerable intake of chemicals listed in this report are taken from statements published by established sources such as the World Health Organization, the U.S. Environmental Protection Agency and the U.S. National Academy of Sciences. Only where necessary did the Committee develop its own recommendations. The information leading to an expression of concern by the Committee for human exposure to certain Great Lakes chemicals is subject to update as new information on toxicity becomes available. Therefore some of the values for maximum tolerable intake are provisional. Data on exposure potential are also tentative as the relative contribution of the various routes of exposure of many of the chemicals is incompletely known. It may well be that, with the limited resources, an iterative process is the most effective route to obtain the type of data required for good management decisions. The responsibility for advising the public rests with the jurisdictions. They must use their own resources to assess the risk to their populations from all sources affecting their respective geographic areas. The resources available to the jurisdictions are, for the most part, larger than those of the International Joint Commission. The Committee is also following developments in the field of research on tumors in Great Lakes fish, particularly their potential to serve as indicators of contamination with chemicals which act as complete carcinogens, initiators or promoters. This report presents a brief statement on this subject. (Lantz-PTT)
W88-02266

EVALUATION OF IRRIGATION MANAGEMENT PROCEDURES FOR GEOTHERMAL EFFLUENT,
Idaho Water Resources Research Inst., Moscow.
For primary bibliographic entry see Field 3C.
W88-02268

MOUNT ST. HELENS: THE AFTERMATH,
Bureau of Reclamation, Washington, DC. Office of Water Research.
For primary bibliographic entry see Field 5G.
W88-02272

INTRODUCTION TO ENVIRONMENTAL SCIENCE,
Wisconsin Univ.-Green Bay.
For primary bibliographic entry see Field 5A.
W88-02321

MERCURY IN THE ECOSYSTEM: ITS DISPERSION AND POLLUTION TODAY,
Jadavpur Univ. (India). Dept. of Geology.
For primary bibliographic entry see Field 5B.
W88-02323

PHYSIOLOGICAL EFFECTS OF METAL TOXICITY ON THE TROPICAL FRESHWATER SHRIMP MACROBRACHIUM CARCINUS (LINNEO, 1758),
Universidad de Oriente, Cumana (Venezuela). Inst. Oceanografico.
M. Correa.
Environmental Pollution, Vol. 45, No. 2, p 149-155, 1987. 1 fig, 3 tab, 18 ref. Universidad de Oriente CI-5-019-00284/85.

Descriptors: *Water pollution effects, *Heavy metals, *Toxicity, *Shrimp, Zinc, Copper, Respiration, Ammonia, Gills, Carbohydrates, Lipids.

Pilot tests were performed to determine the level at which Zn(2+) and Cu (2+) ceased to be acutely toxic in Macrobrachium carcinus. The data indicated that the static 96h-LC50 values for Zn(2+) and Cu(2+) were 0.2 and 0.1 mg respectively. A differential reduction in respiration and ammonia excretion rates was noted with increasing concentrations of these metals in the water. These levels may result in a toxic body burden and a progressive deterioration of gill efficiency. A decrease in respiration and ammonia excretion rates resulted in a decrease in O:N ratios, upon exposure to Zn(2+) and Cu(2+) concentrations. The ratios obtained indicate that these metals, also increased dependence on carbohydrate or lipid reserves. (Author's abstract)
W88-02335

ADDITION OF NAOH, LIMESTONE SLURRY AND FINEGRAINED LIMESTONE TO ACIDIFIED LAKE WATER AND THE EFFECTS ON SMOLTS OF ATLANTIC SALMON (SALMO SALAR L.),
Direktoratet for Vilt og Ferskvannsfisk, Trondheim (Norway). Fish Research Div.
For primary bibliographic entry see Field 5G.
W88-02342

COPPER AS AN ALGICIDE IN A TROPICAL RESERVOIR,
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Botany.
For primary bibliographic entry see Field 5G.
W88-02347

SELECTIVE REMOVAL OF REEF FISH ASSOCIATED WITH AN OFFSHORE COOLING-WATER INTAKE STRUCTURE,
Occidental Coll., Los Angeles, CA.
M. Helvey, and P. B. Dorn.
Journal of Applied Ecology JAPEAI, Vol. 24, No. 1, p 1-12, April 1987. 3 fig, 5 tab, 30 ref.

Descriptors: *Cooling water intakes, *Intakes, *Population density, *Fish behavior, Temporal variation, Field tests.

Fish captured, tagged and released at an offshore intake structure, together with a comparison of field population densities and respective impingement rates, indicated intake removal to be a selective process. Intake-associated species comprised a small proportion of the total number of fish removed and were not removed in numbers proportional to their field densities. The rheotropic behavior of four species associated with the intake structure demonstrated that, given adequate water clarity, they avoided being trapped by intake water currents. Diurnally active species seeking benthic cover at night were least susceptible to intake removal. Diurnally active species that hover in the water column at night and predators that periodically feed at twilight and evening hours were more susceptible to removal. Nocturnal fish were most susceptible to removal. (Author's abstract)
W88-02364

MECHANISM OF TOXICITY OF IONIC COPPER AND COPPER COMPLEXES TO ALGAE,
Commonwealth Scientific and Industrial Research Organization, Sutherland (Australia). Div. of Energy Chemistry.
J. L. Stauber, and T. M. Florence.
Marine Biology MBIOAJ, Vol. 94, No. 4, p 511-519, May 1987. 1 fig, 6 tab, 35 ref.

Descriptors: *Water pollution effects, *Toxicity, *Algae, *Copper, *Complexes, Ions, Photosynthesis, Reproduction, Growth, Diatoms, Heavy metals.

The mechanism of toxicity of ionic copper and copper complexes to growth, photosynthesis, respiration, ATP levels and mitochrondrial electron-transport chain-activity in two marine diatoms, Nitzschia closterium (Ehrenberg) W. Smithy and Asterionella glacialis Castracane, and one freshwater green alga, Chlorella pyrenoidosa Chick was investigated. Copper ions depressed both cell division and photosynthesis in A. glacialis and C. pyrenoidosa, whereas ionic copper concentrations which were inhibitory to cell division in N. closterium had no effect on photosynthesis, respiration, ATP production, electron transport or membrane ultrastructure. This suggests that in N. closterium, copper does not act on the chloroplast, the mitochrondrion, or the cell membrane, since if it did, the above parameters should be affected. Copper-ethylxanthogenate was exceptional among the copper complexes in that it stimulated respiration, mitochrondrial electron-transport and ATP formation in N. closterium under conditions of strongly inhibited cell division and slightly stimulated photosynthesis. Ionic copper toxicity may result from a intracellular reaction between copper and reduced glutathione (GSH), leading to a lowering of the GSH:GSSG ratio and suppression of mitosis. In addition, copper inhibits the enzyme catalase and reduces cell defence mechanisms against H2O2 and oxygen-free radicals. Lipid-soluble copper complexes are more toxic than ionic copper because both the metal and the ligand are introduced into the cell. Toxicity of ionic copper is ameliorated by trivalent metal ions in the growth medium, including those of Mn, Co, Al, Fe and Cr which form a layer of metal (III) hydroxide around the algal cell, adsorb copper and reduce its penetration into the cell. The degree of insolubility of the metal (III) hydroxide is related to its ability to protect against copper toxicity. In addition, manganese and cobalt catalytically scavenge damaging H2O2 and superoxide radicals, respectively, produced by the cell. (Author's abstract)
W88-02369

REPRODUCTIVE BIOLOGY AND THE PATHOLOGICAL CHANGES OF THE PLAICE PLEURONECTES PLATESSA (L.) AFTER THE 'AMOCO CADIZ' OIL SPILL ALONG THE NORTH-WEST COAST OF BRITTANY,

Universite de Bretagne-Occidentale, Brest (France). Lab. de Biologie Animale.
T. Brule.

Journal of the Marine Biological Association of the United Kingdom JMBAAK, Vol. 67, No. 2, p 237-247, May 1987. 5 fig, 3 tab, 18 ref.

Descriptors: *Estuaries, *Oil spills, *Water pollution effects, *Fish pathology, *Reproduction, *Amoco-Cadiz, *Plaice, Spawning, Fish physiology, Histology, Hydrocarbons.

Plaice captured along the north-west coast of Brittany become mature at four years and at 38-40 cm length. The spawning period occurs in February and March. Low gonadosomatic index and histological anomalies of ovaries have been observed during the reproductive period. The presence of hydrocarbons in the estuaries and their sediments, resulting from the 'Amoco Cadiz' wreck, seems to be responsible for the alterations in oogenesis of disturbed females. The results are compared with those obtained by other authors in the same area and in other geographic zones. (Author's abstract)
W88-02372

SENSITIVITY OF HIGH-ELEVATION STREAMS IN THE SOUTHERN BLUE RIDGE PROVINCE TO ACIDIC DEPOSITION,

Georgia Univ., Athens. Dept. of Sociology and Anthropology.
P. V. Winger, P. J. Lasier, M. Hudy, D. Fowler, and M. J. Van Den Avyle.

Water Resources Bulletin WARBAQ, Vol. 23, No. 3, p 379-386, June 1987. 3 fig, 2 tab, 30 ref.

Descriptors: *Water pollution effects, *Acid deposition, *Acid rain, *Streams, Alkalinity, Water chemistry, Acidity, Ions, Monitoring.

The Southern Blue Ridge Province, which encompasses parts of northern Georgia, eastern Tennessee, and western North Carolina, has been predicted to be sensitive to impacts from acidic deposition, owing to the chemical composition of the bedrock geology and soils. This study confirms the predicted potential sensitivity, quantifies the level of total alkalinity and describes the chemical characteristics of 30 headwater streams of this area. Water chemistry was measured five times between April 1983 and June 1984 at first and third order reaches of each stream during baseflow conditions. Sensitivity based on total alkalinity and the Calcite Saturation Index indicates that the headwater streams of the Province are vulnerable to acidification. Total alkalinity and pH were generally higher in third order reaches (mean, 72 micro-eq/L and 6.7) than in first order reaches (64 micro-eq/L and 6.4). Ionic concentrations were low, averaging 310 and 340 micro-eq/L in first and third order reaches, respectively. A single sampling appears adequate for evaluating sensitivity based on total alkalinity, but large temporal variability requires multiple sampling for the detection of changes in pH and alkalinity over time. Monitoring of stream water should continue in order to detect any subtle effects of acidic deposition on these unique resource systems. (Author's abstract)
W88-02377

UNAVAILABILITY OF POLYNUCLEAR AROMATIC HYDROCARBONS FROM COAL PARTICLES TO THE EASTERN OYSTER,

Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5B.
W88-02421

INTERACTION OF TRACE METALS ZN, CD, AND MN, WITH CA CONCRETIONS IN THE GILLS OF FRESHWATER UNIONID MUSSELS,

Louisiana State Univ., Baton Rouge. Dept. of Zoology and Physiology.
H. Silverman, J. W. McNeil, and T. H. Dietz.

Canadian Journal of Zoology CJZOAG, Vol. 65, No. 4, p 828-832, April 1987. 2 fig, 3 tab, 15 ref. NSF Grants DCB 8303789 and DCB 8518221.

Descriptors: *Calcium concretions, *Water pollution effects, *Isotope studies, *Heavy metals, *Mussels, Gills, Zinc, Manganese, Cadmium, Calcium, Cations, Reproduction.

The interaction of Zn, Mn, and Cd with Ca concretions in the gills of unionid mussels was investigated. Raising blood levels of these ions to twice their normal values for a week does not result in significant deposition of these metals into gill concretions. The interaction of Zn with the concretions was examined in more detail both in vivo and in vitro. Isolated concretions bind Zn as rapidly as Ca. However short-term in vivo labelling studies using radiolabelled Zn and Ca verify that Zn is not added to concretions while Ca is being rapidly accumulated. These studies demonstrate that calcium concretions from the gills of unionid mussels do not indiscriminately bind divalent cations, but precisely regulate the species of divalent cation incorporated. This is further evidenced by the lack of relationship between blood or pond water cation levels and the levels of specific cations found in the concretions. Since the concretions are mobilized during the reproductive period, and serve as a source of glochidial calcium, it would be disadvantageous for these concretions to bind divalent cations for detoxification purposes. (Author's abstract)
W88-02424

CASE-CONTROL STUDY OF COLON CANCER AND DRINKING WATER TRIHALOMETHANES IN WISCONSIN,

Wisconsin Univ.-Madison. Dept. of Preventive Medicine.
T. B. Young, D. A. Wolf, and M. S. Kanarek.

International Journal of Epidemiology IJEPBF, Vol. 16, No. 2, p 190-197, June 1987. 1 fig, 5 tab, 18 ref, append.

Descriptors: *Colon cancer, *Water pollution effects, *Trihalomethanes, *Case studies, *Population exposure, Drinking water, Chlorination, Diet, Surveys, Model studies, Wisconsin.

A case-control study was conducted to test the hypothesis that chronic ingestion of trihalomethanes (THMs), occurring as chlorination byproducts in drinking water, carries a risk of colon cancer. Lifetime residential and water source histories and information on water-drinking habits, diet, sociodemographics, medical and occupation histories, lifestyle and other factors were obtained by questionnaire from a statewide sample of newly-diagnosed colon cancer cases (N = 347), controls with cancer of other sites (N = 639) and general population controls (N = 611). Since no data on past THM levels exists, it was necessary to devise a scheme to generate THM estimates for all Wisconsin water sources. For this, a statistical model based on quantitative THM measures and routinely-recorded data taken at 81 municipal water facilities was used in conjunction with individual residential histories to estimate odds ratios adjusted for age, sex and urban living, for colon cancer and THM exposure. The study results indicate that THM in Wisconsin drinking water does not pose a significant colon cancer risk. Odds ratios for exposure to the middle and highest category of lifetime cumulative THM were 1.05 (95% CI = 0.66-1.68) and 0.93 (95% CI = 0.55-1.57) respectively, relative to the cancer control group, and 1.10 (95% CI = 0.68-1.78) and 0.73 (95% CI = 0.44-1.21) respectively, relative to the general population controls. Odds ratios based on other THM exposure variables, including cumulative THM indices for 10-30 year periods and dichotomous surrogate variables, were close to 1.00 with few exceptions, consistent with the conclusion that THM exposure is not associated with colon cancer. (Author's abstract)
W88-02426

HEALTH SIGNIFICANCE OF CHLORINATION BYPRODUCTS IN DRINKING WATER: THE HOUSTON EXPERIENCE,

Texas Univ. Health Science Center at Houston. School of Public Health.
I. Cech, A. H. Holguin, A. S. Littell, J. P. Henry, and J. O'Connell.

International Journal of Epidemiology IJEPBF, Vol. 16, No. 2, p 198-207, June 1987. 4 fig, 2 tab, 38 ref. NCI Grant (5R01-CA 24138-01).

Descriptors: *Cancer, *Mortality, *Water pollution effects, *Trihalomethanes, *Case studies, *Population exposure, Drinking water, Chlorination, Diet, Surveys, Houston, Texas.

In 1954, following the construction of Lake Houston, a change from lightly chlorinated ground sources to a heavily chlorinated surface source of drinking water took place for a sizable part of the population in the city of Houston, Texas. This has provided the opportunity to compare the incidence of urinary tract cancer mortality in populations exposed to heavily chlorinated and lightly chlorinated drinking water. The spatial, diurnal, and seasonal concentrations of chlorination byproducts (trihalomethanes) in Houston water were assessed. The range of concentrations varied from below the limits of detection in treated groundwater, to more than 200 mg/L (twice the level allowed by US drinking water standards) in treated lake water. The mortality experience by gender, by race, and by age cohorts for the period 1940 to 1970 from urinary tract cancers to the surface water. By the 1970's 20 years following the switch to surface water, an increase was detected in urinary cancer mortality rates for white females without a corresponding increase observed for white males. No clear-cut trends were found for the non-white population. On balance, a detrimental urinary cancer effect associated with a switch to chlorinated surface water has not been demonstrated yet. (Author's abstract)
W88-02427

SOIL NUTRIENT LEACHING IN RESPONSE TO SIMULATED ACID RAIN TREATMENT,
Tennessee Valley Authority, Chattanooga. Div. of Air and Water Resources.
J. M. Kelly, and R. C. Strickland.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 2, p 167-181, June 1987. 4 fig, 6 tab, 24 ref.

Descriptors: *Water pollution effects, *Acid rain effects, *Soil water, *Nutrients, *Leaching, *Simulated rainfall, Ions, Leachates, Acidity, Cations.

Soil and soil solution nutrient concentrations were evaluated over a 30-mo period to determine the impact of simulated acidic precipitation (70:30 equivalent basis H2SO4:HNO3) at pH values of 5.7, 4.5, 4.0, and 3.5 on forest microcosms. Soil nutrient analysis indicated significantly lower concentrations of exchangeable Ca and Mg in the top 3.5 cm of the mineral soil after 30 mo of pH 3.5 treatment. Leachate collected from the pH 4.5, 4.0, and 3.5 treatments at the 25 cm depth (below the A horizon) exhibited significant increases Cl, NH4, PO4, K, and SO4 concentrations compared to the pH 5.7 treatment. At the 50 cm depth (mid-profile) all leachate element concentrations except NH4 increased significantly in response to treatment. At the 100 cm depth (profile bottom), no significant effects of treatment on leachate chemistry were observed. The elevated base cation concentration values found in the 50 cm soil solution samples support at least partially the described reduction in Ca and Mg in the surface soil horizon. The 100 cm concentration data indicate that cations mobilized out of the A and upper B horizon in response to treatment were immobilized before reaching the bottom of the soil profile. Evaluation of nutrient flux out of the microcosm at the 100 cm depth did not indicate any statistically significant response to the treatment. Nitrate rather than SO4 was found to be the dominant anion leaving the microcosm by an average factor of 7 to 1. (Author's abstract)
W88-02458

AEROMONAS HYDROPHILA DENSITIES IN THERMALLY-ALTERED RESERVOIR WATER AND SEDIMENTS,
Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
G. A. Burton, and G. R. Lanza.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 2, p 199-206, June 1987. 7 fig, 1 tab, 16 ref.

Descriptors: *Eutrophic reservoirs, *Aeromonas, *Limnology, *Water pollution effects, *Thermal pollution, *Temperature effects, *Population dynamics, Plumes, Microorganisms, Monitoring, Temperature, Sediments, Seasonal variation.

Aeromonas hydrophila densities were monitored in waters and sediments over a 1-yr period in a eutrophic Texas reservoir receiving power plant cooling waters. A. hydrophila densities were elevated in warmer waters located in the power plant cooling water plume as compared to a control station. A. hydrophila concentrations in the plume correlated well with water temperature and conductivity throughout the year. Densities at the control site were not as well correlated with temperature or conductivity. Sediment densities of A. hydrophila were also elevated at plume stations, but did not show the clear seasonal fluctuations noted in overlying waters. (Author's abstract)
W88-02461

RESPONSE OF TWO WESTERN CANADIAN CONIFERS TO SIMULATED ACIDIC PRECIPITATION,
Saskatchewan Research Council, Saskatoon.
Z. M. Abouguendia, and L. A. Baschak.
Water, Air, and Soil Pollution WAPLAC, Vol. 33, No. 1/2, p 15-22, March 1987. 9 tab, 15 ref.

Descriptors: *Water pollution effects, *Acid rain effects, *Simulated rainfall, Pine trees, Spruce trees, Chlorophyll, Acidity, Nutrients, Sulfur.

Ready-to-plant nursery stock of jack pine (Pinus banksiana Lamb.) and white spruce (Picea glauca (Moench) Voss) were subjected to simulated acid rains of pH 5.6 (control), 4.6, 3.6, and 2.6 under controlled growth room conditions to determine the threshold for damage. The two species exhibited contrasting response patterns to simulated acid rain treatments. Growth and chlorophyll content of jack pine were not adversely affected at any of the levels applied. Furthermore, no macroscopic foliar injury symptoms were evident and foliar nutrient levels remained unaffected. White spruce showed no statistically significant reduction in growth rate at any of the treatments. Needle chlorophyll a content of white spruce was not affected by any of the treatments, while chlorophyll b level was significantly reduced at pH 2.6. Symptoms of visible injury were observed to increase with rain acidity. No statistically significant change in the levels of foliar nutrients of white spruce were found, with the exception of the elevated S concentration at pH 2.6. (Author's abstract)
W88-02464

RESPONSE OF TWO ADIRONDACK WATERSHEDS TO ACIDIC DEPOSITION,
Electric Power Research Inst., Palo Alto, CA. Environmental Assessment Dept.
E. A. Fendick, and R. A. Goldstein.
Water, Air, and Soil Pollution WAPLAC, Vol. 33, No. 1/2, p 43-56, March 1987. 9 fig, 2 tab, 33 ref.

Descriptors: *Water pollution effects,. *Acid rain effects, *Watersheds, *Acid rain, *Model studies, Sulfur, Nitrogen, Simulation, Deposition.

Responses of two lake-watersheds to changes in atmospheric deposition were simulated using the Integrated Lake-Watershed Acidification Study (ILWAS) Model. The simulated annual chemical outlet fluxes were continuous functions of both S and N deposition. No acidification threshold was observed. The slopes of the response curves quantified the contrasting sensitivities of the two systems to changes in deposition. For the watershed response curves generated by these depositional simulations, there is no indication of a threshold response over the range of zero sulfate or nitrate deposition through two times current loading. Instead, the outlet response is predicted as a continuum from zero loading up through double the base-case deposition. An exception is nitrate outlet flux, which shows a threshold type of response occurs above base-case loading, which is approximately three times the proposed threshold amount. Aluminum outlet flux, while not showing a threshold response, does increase rapidly at high anion loadings, due to increased mobilization at low pH. More important than the question of whether or not a threshold response exists, is the question of whether or not a region can be characterized by a single quantitative response function. Even if a response for individual lakes was threshold, if the deposition level at which the threshold occurred was highly variable among lakes, then the aggregate response function for a large number of lakes would tend toward being continuous. The results of the analysis reported support the general conclusion of ILWAS that there exists large variation among lake-watersheds both in terms of absolute response and sensitivity at different levels of deposition acidity. This implies that the response of a region needs to be characterized by a probability distribution that takes into consideration the variation in watershed properties within the region. (Alexander-PTT)
W88-02465

EFFECT OF SODIUM CHLORIDE AND CALCIUM CHLORIDE ON NITRITE INDUCED METHEMOGLOBINEMIA IN CLARIAS LAZERA,
Alexandria Univ. (Egypt). Dept. of Zoology.
A. M. Hilmy, N. A. El-Domiaty, and K. Wershana.
Water, Air, and Soil Pollution WAPLAC, Vol. 33, No. 1/2, p 57-63, March 1987. 4 fig, 16 ref.

Descriptors: *Water pollution effects, *Sodium chloride, *Calcium chloride, *Chlorides, *Clarias, *Methemoglobinemia, *Nitrites, Ions, Inhibition, Fish.

Guidelines are given for the manipulation of some inorganic ions to prevent nitrite toxicity in fish hatcheries, and treatment methodology is recommended for the event nitrite poisoning does occur. The protective effects of environmental chlorides (as NaCl and CaCl2) on nitrite-induced methemoglobinemia to the fresh water teleost Clarias lazera were studied. Two aspects investigated include the determination of the minimum ratio of chloride to nitrite ion required to inhibit nitrite-induced methemoglobinemia, and the ability of chloride to reverse methemoglobin formation in fish previously exposed to nitrite. Methemoglobin levels were not elevated in either size of Clarias lazera when fish were simultaneously exzposed for 24 and 48 hr to nitrite and NaCl at a molar ratio of 26.6:1 and 18:1 (Cl:NO2). This protective effect of chloride was interpreted as due to its ability to compete with nitrite for chloride uptake sites. Calcium chloride inhibited nitrite-induced methemoglobinemia more effectively than NaCl. Recovery from nitrite-induced methemoglobinemia occurred when previously dosed fish were transferred to water containing the same nitrite concentration and NnaCl or CaCl2. This indicates that Clarias lazera possesses a methemoglobin-reductase system. The presence of chloride ions may result in a competitive inhibition of nitrite uptake, thus allowing the reductase system to reduce methemoglobin back to hemoglobin. (Alexander-PTT)
W88-02466

IMPACT OF A CHLOR-ALKALI PLANT ON ONONDAGA LAKE AND ADJOINING SYSTEMS,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler.
Water, Air, and Soil Pollution WAPLAC, Vol. 33, No. 1/2, p 85-115, March 1987. 14 fig, 2 tab, 105 ref.

Descriptors: *Water pollution effects, *Streams, *Chlor-alkali plants, *Salinity, *Stratification, *Nutrient availability, *Lake Onondaga, *New York, *Heavy metals, *Lakes, *Rivers, Industrial wastewater, Ions, Fish, Oxygen.

The pervasive effects an adjoining chlor-alkali plant has had on Onondaga Lake, and the river system that receives the lake discharge, are documented. Effects of the ionic waste discharge of the facility include: (1) ionic enrichment, (2) altered stratification regimes, (3) altered exchange between the lake and river, (4) altered hydrodynamics in the river downstream of the lake, (5) precipitation and deposition of large quantities of calcium carbonate, and (6) altered chemistry of lake sediments regulating P availability. Mercury, benzene, chlorobenzene wastes from the plant have contaminated the sediments and fish of the lake. Deleterious effects of the facility have included: the elimination of fish habitat, exacerbation of the problem of limited oxygen resources of the hypolimnion, contamination of fish flesh, exacerbation of the problem of low transparency of the lake, and severe oxygen depletion in the lower waters of the river system. (Author's abstract)
W88-02467

BIOMASS AND COMPOSITIONAL CHANGES IN THE PERIPHYTIC COMMUNITY OF AN ARTIFICIAL STREAM IN RESPONSE TO LOWERED PH,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
C. G. Maurice, R. L. Lowe, T. M. Burton, and R. M. Stanford.
Water, Air, and Soil Pollution WAPLAC, Vol. 33, No. 1/2, p 165-177, March 1987. 3 fig, 4 tab, 23 ref.

Descriptors: *Water pollution effects, *Streams, *Simulation, *Acidity, *Acid rain effects, *Algae, *Hydrogen ion concentration, *Biomass, Nutrients, Ions, Deposition.

Two artificial streams simulating low order, softwater streams of the Upper Peninsula of Michigan were employed to examine the effects of lowered pH on periphytic algae. The control stream contained water with a circumneutral pH whereas the pH of the water in the acidified stream was decreased to pH 4 with H2SO4. Chlorophyll a

concentrations and cell densities in the periphytic algal communities were used to measure differences in biomass accumulations between the 2 streams over a 42-d, spring colonization period. Relative abundances of algal genera and Stander's similarity index (SIMI) were used to examine compositional differences between the control and acidified periphytic algal communities. These algal comunities exhibited pronounced differences in their total biomasses and compositions indicating that periphytic algal communities inhabiting low-order, softwater streams, such as those of the Upper Peninsula of Michigan, are vulnerable to acidic deposition. Decreased biomass accumulation under acidified conditions was believed to result primarily from decreased nutrient availability, and possibly secondarily from elevated aluminum and/or iron concentrations. The shift in community compositions was interpreted to be a more direct response to the lowered pH as acidophils and acid tolerant genera became favored, and thus more abundant. (Author's abstract)
W88-02468

ROLE OF ALUMINIUM CONTAMINATION IN DETERMINING PHYTOPLANKTON AND ZOOPLANKTON RESPONSES TO ACIDIFICATION,
West Virginia Univ., Morgantown. Dept. of Biology.
K. E. Havens, and J. Decosta.
Water, Air, and Soil Pollution WAPLAC, Vol. 33, No. 3/4, p 277-293, April 1987. 7 fig, 2 tab, 38 ref.

Descriptors: *Water pollution effects, *Bioassays, *Lakes, *Limnology, *Acid rain effects, *Algae, *Aluminum, *Acidification, Phytoplankton, Zooplankton, Species composition.

A bioassay was performed at neutral pH Lake O'Woods, West Virginia using in situ enclosures. Replicated enclosures were either (a) untreated controls, (b) acidified to pH 4.7, or (c) acidified and spiked with 300 microgram(ug)/L Al. Algal and zooplankton responses to the treatments were compared to determine whether the impacts of acidification are influenced by Al concentration. With acidification, chlorophyll a concentration increased but zooplankton abundance did not change. The phytoplankton became dominated by the dinoflagellate Peridinium inconspicuum, while in the control, diatoms, euglenophytes and chlorophytes were dominant. Acidification did not result in succession in the zooplankton because all of the dominant species at the start of the experiment were acid tolerant. Aluminum addition resulted in reduced chlorophyll a concentration and zooplankton abundance. The same phytoplankton and zooplankton became dominant in the acid and acid plus Al treatments. This suggests a linkage between the ability to tolerate elevated H(+) and elevated Al levels. (Author's abstract)
W88-02471

PHYSIOLOGICAL RESPONSES OF SOYBEAN (GLYCINE MAX L. MERR) TO SIMULATED ACID RAIN AND AMBIENT OZONE IN THE FIELD,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
B. K. Takemoto, D. S. Shriner, and J. W. Johnston.
Water, Air, and Soil Pollution WAPLAC, Vol. 33, No. 3/4, p 373-384, April 1987. 6 fig, 4 tab, 21 ref. EPRI Contract 1908-2 and DOE Contract DE-AC05-840R21400.

Descriptors: *Water pollution effects,. *Acid rain effects, *Soybeans, *Simulated rainfall, *Ozone, *Field tests, Plants, Acidity, Rainfall, Tissue analysis.

Physiological processes in field-grown soybean (Glycine max L. Merr. 'Davis') were monitored to determine if plant responses were altered by simulated acid rain and if the responses to acid rain were modified by the presence of gaseous pollutants. Applications of simulated acid rain (pH 3.2, 4.2, and 5.2), alone or in combination with gaseous pollutants, did not significantly affect photosynthesis, transpiration, stomatal conductance of water vapor, or chlorophyll content at periodic intervals during the 1984 season. Furthermore, in leaf samples collected during pod fill, the concentrations of 11 elements were not significantly affected by simulated acid rain, alone or in combination with gaseous pollutants. These data are evidence that combinations of ambient rain and gaseous pollutants at similar levels may not cause significant physiological disruption in field-grown Davis soybean, and provide mechanistic support for studies where no significant effects on yield were reported. (Author's abstract)
W88-02473

PROFUNDAL MACROBENTHOS STRUCTURE AS A MEASURE OF LONG-TERM ENVIRONMENTAL STRESS IN A POLLUTED LAKE,
Rome Univ. (Italy). Dept. of Animal and Human Biology.
M. Bazzanti, and M. Seminara.
Water, Air, and Soil Pollution WAPLAC, Vol. 33, No. 3/4, p 435-442, April 1987. 2 fig, 2 tab, 38 ref.

Descriptors: *Water pollution effects, *Lakes, *Limnology, *Sediments, *Macrobenthos, Surveys, Taxonomy, Temporal variation.

Profundal macrobenthic community in a polluted lake (Lake Nemi, Italy) was analyzed in three distinct surveys from 1976 to 1984, in order to define long-term changes in environmental conditions of sediments. Profundal macrobenthos was mainly composed of Oligochaeta. Only a few Chironomidae and a few other taxa were characteristically found in the superior zone. The long-term stress, due to persistent hypolimnetic O2 deficit, caused progressive simplification of the total community structure. This leads to a high faunal similarity among stations at different depths. The temporal trend of the community structure parameters and the significant role of some taxa (Potamothrix heuscheri, Procladius and Chaoborus flavicans) in the eutrophication process of the lake are also discussed. (Author's abstract)
W88-02474

IN SITU STUDIES AND EXPERIMENTS OF THE ECOTOXICOLOGY OF FOUR METALS (CD, PB, CU, ZN) ON ALGAE AND GRAZING MOLLUSKS (GASTROPODA) (ETUDES IN SITU ET EXPERIMENTALES DE L'ECOTOXICOLOGIE DE QUATRE METAUX (CD, PB, CU, ZN) CHEZ DES ALGUES ET DES MOLLUSQUES GASTEROPODES BROUTEURS),
Nantes Univ. (France). Centre de Dosage des Elements Traces.
C. Amiard-Triquet, C. Metayer, J. C. Amiard, and B. Berthet.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 1, p 11-30, May 1987. 6 fig, 7 tab, 36 ref.

Descriptors: *Water pollution effects, *Limnology, *Coastal waters, *Heavy metals, *Bioaccumulation, *Ecotoxicology, *Algae, *Mollusks, *Gastropods, Field tests, Food chains, Population exposure.

A field study was carried out from March 1982 to May 1984 in the bay of Bourgneuf a French coastal area mainly devoted to oyster culture and comparatively unpolluted seawater, three species of algae (Fucus serratus, Ulva lactuca, Porphyra sp.), 15 specimens of flat top shell (Gibbula umbilicalis) and of edible periwinkle (Littorina littorea) were collected monthly. In experimental studies, both the gastropods were exposed for 4, 8, or 16 days to a large range of Zn overloads whereas the periwinkles alone were contaminated by Cd. For Cd and Pb, the field and experimental studies do not corroborate the hypothesis of a biomagnification in the food chain Algae to grazing Gastropods. The source of the high levels of Cu registered in primary consumers remains questionable. In the bay of Bourgneuf, the levels of Zn in gastropods are equal to or higher than its levels in the food species, but this metal is regulated as shown experimentally. As a consequence of the regulation of the essential trace metals, the levels of Cu and Zn in Gastropods will be partly independent of their concentrations in the environment, at least in moderately polluted areas. Acute pollutions themselves could remain undetected since short-term exposures to high levels of Zn do not disturb significantly the Zn concentrations in G. umbilicalis and L. littorea. (Alexander-PTT)
W88-02476

RESISTANCE OF THE CARIBOU LICHEN CLADINA STELLARIS (OPIZ.) BRODO TO GROWTH REDUCTION BY SIMULATED ACIDIC RAIN,
McGill Univ., Montreal (Quebec). Dept. of Biology.
M. J. Lechowicz.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 1, p 71-77, May 1987. 2 fig, 2 tab, 29 ref.

Descriptors: *Water pollution effects,. *Acid rain effects, *Lichens, *Growth, *Simulated rainfall, Rainfall, Plants, Sulfates, Nitrates, Acidification, Ions, Acidity.

Natural mats of C. stellaris growing in the subarctic lichen woodlands of northern Quebec were treated in a randomized complete block design with solutions of simulated rain at pH 2.5, 3.0, 3.5, 4.0, 4.5, 5.0 and 5.6. These solutions were acidified by addition of mixtures of sulfuric and nitric acids to give both 2:1 and 6:1 microequivalent ratios of SO4(2-):NO3(-). After two years of acidification there was no significant effect of either pH or SO4(-):NO3(-) ratio on the growth of C. stellaris, but thallus discoloration was evident below pH 3.5. After three years of acidification marginally significant ($p = 0.05$) but erratic depression of growth occurred under the 6:1 but not the 2:1 acidification regime, especially at pH 4.5 or less. Acid precipitation therefore only very gradually impairs the growth of C. stellaris, and the deleterious effects of acidification may be partially offset by nitrogen enrichment when precipitation is relatively rich in nitrate compared to sulfate ions. (Author's abstract)
W88-02479

PH PROFILES FROM DIATOM STRATIGRAPHIES IN SEDIMENT CORES OF SELECTED LAKES OF NEW BRUNSWICK AND NOVA SCOTIA, CANADA,
Department of Fisheries and Oceans, St. Andrews (New Brunswick). Biological Station.
J. K. Elner, and S. Ray.
Water, Air, and Soil Pollution WAPLAC, Vol. 32, No. 1/2, p 17-29, January 1987. 7 fig, 1 tab, 31 ref.

Descriptors: *Sediment cores, *Hydrogen ion concentration, *Profiles, *Paleolimnology, *Lakes, *Limnology, *Acid rain, Acidity, Acidification, Nova Scotia, Buffers.

Diatom-inferred pH profiles have been constructed using the log alpha index for three lakes in Nova Scotia and four lakes in New Brunswick, Canada. The profiles cover the last 150 yr, including the past 70 to 80 yr when acid precipitation was increasing. The diatom-inferred pH changed from 6.1 to 5.3 for an unbuffered lake and from 6.3 to 6.1 for the buffered lake near Halifax, Nova Scotia, during the past 70 yr but no change in pH occurred in an unbuffered lake situated in the south of the province. Since 1900, the acidity of two unbuffered lakes in New Brunswick has changed from 6.5 to 6.1 and 6.2 to 5.7. There was no change in pH for the naturally-buffered lake and a third unbuffered lake in New Brunswick. The study suggests that there was a decline in pH of lake water in some unbuffered lakes of New Brunswick and Nova Scotia. (Author's abstract)
W88-02482

LONG-TERM CHANGES IN FISH POPULATIONS OF ACID STREAMS AND LOCHS IN GALLOWAY SOUTH WEST SCOTLAND,
Freshwater Fisheries Lab., Pitlochry (Scotland).
For primary bibliographic entry see Field 2H.
W88-02485

BIOAVAILABILITY OF SEDIMENT-SORBED ORGANIC CHEMICALS: A REVIEW,

Lawrence Livermore National Lab., CA. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W88-02492

5D. Waste Treatment Processes

MANAGEMENT OF WATER TREATMENT PLANT SLUDGES,
Michigan State Univ., East Lansing. Coll. of Engineering.
For primary bibliographic entry see Field 5E.
W88-01502

IMPACT OF SEPTIC TANK SLUDGE ON MUNICIPAL WASTEWATER TREATMENT PLANTS,
McNamee, Porter and Seeley, Ann Arbor, MI.
For primary bibliographic entry see Field 5E.
W88-01503

SLUDGE CHARACTERISTICS,
Wilkins and Wheaton Engineering Co., Kalamazoo, MI.
For primary bibliographic entry see Field 5A.
W88-01504

ESTABLISHING A SLUDGE SAMPLING PROGRAM,
Western Michigan Environmental Services, Inc., Holland, MI.
L. R. Dell.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 91-97, 12 ref.

Descriptors: *Sludge, *Pollutant identification, *Sampling, Industrial wastes, Municipal wastes, Physical properties, Chemical properties, Biological properties.

Sample collection is an important part of any survey or evaluation to assess an industrial or municipal waste. Even with the most precise or accurate analytical measurements and detailed engineering calculations, the results of such a sludge evaluation survey or a process design based on that survey may be of less than desirable value without proper sample collection techniques. The objective of a sludge sampling program is to extract a small representative sample that will accurately reflect the physical, chemical and biological characteristics of the overall sludge system at the time of sampling. A number of factors determine how representative a sample can be and what degree of representativeness is actually required, e.g., the process from which the sample will be drawn, the temperature and age of the sludge, and its consistency, flowrate, and volume. These factors are reviewed for their effect on a sludge sampling program and how the program should be designed to take these factors into account. The scope of this discussion is limited to presenting an outline to be followed in establishing a sampling program. (See also W88-01499) (Lantz-PTT)
W88-01505

CONCEPTS, COSTS AND USES OF GAS CHROMATOGRAPHY AND GAS CHROMATOGRAPHY/MASS SPECTROSCOPY IN THE ANALYSIS OF SLUDGE,
Environmental Research Group, Inc., Ann Arbor, MI.
For primary bibliographic entry see Field 5A.
W88-01506

AESTHETIC RENOVATION,
Site Planning Development Inc., Charlevoix, MI.
For primary bibliographic entry see Field 5E.
W88-01510

STUDY OF ZINC AND COPPER REMOVAL BY IRON (III) AND (II) OXYHYDROXIDES,
Porto Univ. (Portugal). Faculdade de Engenharia.
C. J. G. Gonzalez Beca, and R. A. Guedes de Carvalho.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 647-660, 6 fig, 5 tab, 19 ref.

Descriptors: *Zinc, *Wastewater treatment, *Copper, *Iron, *Oxyhydroxides, Hydrogen ion concentration, Chemical treatment, Calcium, Adsorption.

Zinc and copper removal by iron (III) and (II) oxyhydroxides as a function of pH (5.0-12.5 range) and iron suspension concentration, was studied, along with the influence of calcium present, as calcium chloride, nitrate or sulfate. It can be concluded that while Fe(II)OH acts a better zinc adsorbent than Fe(III)OH in the acid zone (pH 5.0 and 6.0), it is worse in the alkaline zone (pH 7.5). When using Fe(III)OH suspensions at pH 6.0 and with 'standard' concentration, the following conclusions can be drawn: (1) For an equal molar concentration (6/7 mM) and in calcium absence, copper is more adsorbed than zinc (96.3%) compared with 60.7%); (2) Calcium presence diminishes the percentage of copper adsorption, similarly to what happens with zinc; and (3) Variation of copper concentration (in calcium absence) has a more pronounced effect upon adsorption than when zinc is concerned. Concerning the utilization of Fe(II)OH suspensions, at pH 6.0, with 'standard' concentration, it can be concluded that: (1) For an equal molar concentration (6/7 mM), and in the absence of calcium, zinc is more adsorbed than copper (73.7% comparatived with 49.1%); this is contrary to what happens with Fe(III)OH suspensions, at pH 6.0, with 'standard' concentration; (2) Calcium presence decreases the percentage of copper adsorption; and (3) Variation of copper concentration (in calcium absence) has a slightly more marked effect in adsorption than variation of zinc concentration, in the concentration ranges studied. (See also W88-01554) (Lantz-PTT)
W88-01559

REMOVAL OF TOXIC ELEMENTS IN MINE EFFLUENTS BY CCIX,
Himsley Engineering Ltd., Toronto (Ontario).
A. Himsley, and J. A. Bennett.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 661-671, 6 fig, 1 tab, 6 ref.

Descriptors: *Wastewater treatment, *Mine wastes, *Ion exchange, Adsorption columns, Design standards, Adsorption, Wastewater facilities.

Since 1969 Himsley Engineering of Canada has developed continuous ion exchange systems for the treatment of wastewater and mine water effluents. Continuous Ion Exchange has become a state of the art technology for the treatment of waste streams and Himsley Engineering has developed three primary designs: (1) Continuous Upflow with Multi Chamber Adsorption Column; (2) Continuous Downflow Moving Packed Bed Adsorption Column; and (3) Continuous Upflow Open Tank Adsorption Column. These three techniques are discussed in depth, highlighting: (1) design standards; (2) system capacity; (3) adsorption column details; (4) elution process details; and (5) plant operations. (See also W88-01554) (Lantz-PTT)
W88-01560

USE OF CONTROLLED RELEASE BACTERICIDES FOR RECLAMATION AND ABATEMENT OF ACID MINE DRAINAGE,
Goodrich (B.F.) Co., Akron, OH.
For primary bibliographic entry see Field 5G.
W88-01572

INDUSTRIAL WASTEWATER TREATMENT TECHNOLOGY,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
J. W. Patterson.
Butterworths, Boston, MA. Second edition, 1985. 467 p.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Water pollution sources, *Hazardous wastes, *Waste treatment, *Toxic wastes, Aluminum, Arsenic, Barium, Cadmium, Chromium, Copper, Cyanide, Fluoride, Iron, Lead, Manganese, Mercury, Nickel, Nitrogen, Selenium, Silver, Zinc, Phenols, Dissolved solids, Hydrogen ion concentration, Grease, Oil wastes, Pollutant load, Pilot plants, Economic aspects, Water pollution control.

Since the publication of the first edition of 'Wastewater Treatment Technology', a significant body of supplemental information on industrial wastewater pollution control has been generated. The preparation of this second edition was undertaken, in part, to incorporate the new material regarding modern industrial practices in water pollution abatement. In addition, a number of industrial pollutants not included in the first edition have become serious environmental concerns. Thus, the second objective of this revised edition is to address the technologies appropriate for these additional pollutants. This second edition includes 24 chapters, each devoted to a specific pollutant or category of pollutants. The volume is almost twice the size of the previous edition, and the number of references cited has more than doubled. The overall objectives of this work remain are as follows: (1) Identify sources and typical levels of the pollutant discussed; (2) Describe available treatment technology with regard to: (a) how each technology operates and its limitations; (b) what levels of treatment have been accomplished in full-scale treatment systems (preferably), or in pilot-scale systems if no full-scale data are available; (c) the economics of each technique, with regard to comparison of both capital investment requirement, and operating and maintenance costs. and (3) Summarize concisely the major types of technology and effluent levels of pollutant achievable. (Lantz-PTT)
W88-01598

PLATING WASTE TREATMENT,
K. F. Cherry.
Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1982. 324 p.

Descriptors: *Metal-finishing wastes, *Waste treatment, *Wastewater treatment, Solids, Oils, Phenols, Regulations, Costs, Industrial wastewater.

Plating has been growing steadily as one of the nation's major industries. Historically, pollution control technology and economics led to some practices that contributed to pollution problems. These practices and problems were addressed by environmental groups in the 1960s. Congress reacted with the Clean Water Act, which the U.S. EPA bureaucracy converted to thousands of pages of rules, explanations and court decisions. Heavy metals were relatively easy to measure and had more-or-less proven environmental impact, so the plating industry was high on the EPA's target list. As a result, today's plating industry has been studied by scores of EPA-funded projects, and is one of the most environmentally regulated industries. Some economic benefits to the surviving platers have been derived from all this government attention. Aside from the reduction in competition resulting from the closure of some shops, the technology to recover wastes has developed at an amazing pace, and the EPA studies have provided excellent documentation of the available processes. Just a few years ago plating waste treatment was an arcane art; today it is considered a well developed science (except by most who run a job shop waste treatment operation). Chapter topics are: (1) The Basics; (2) Treatment of Common Metal Wastes; (3) Solids Removal; (4) Oils and Phenols; (5) Rinsing; (6) Recovery methods; (7) Special considerations; (8) Specifications; (9) Cost methods; and (10) US EPA Regulations. (Lantz-PTT)
W88-01653

ENVIRONMENTAL ENGINEERING AND SANITATION,
J. A. Salvato.
John Wiley and Sons, New York, NY. Third edition, 1982. 1163 p.

Descriptors: *Environmental engineering, *Wastewater treatment, *Waste disposal,*Waste treatment, *Sanitation, Sanitary engineering, Water supply, Solid waste management, Waste management, Radiation, Human diseases.

Many standard texts adequately cover the specialized aspects of environmental engineering and sanitation; but little detailed information is available in one volume dealing with the urban, suburban, and rural community. In this text, emphasis is placed on the practical application of sanitary science and engineering theory and principles to environmental control. A special effort was made to include general design, construction, maintenance, and operation details as they relate to plants and structures. Examples and drawings are used freely to help in the understanding and use of the subject matter. The reader is referred to the references and bibliography in each chapter for more information on complex designs and problems that are beyond the scope of this text. Since the field is a very broad one, the following subjects are specifically covered in this new revised edition: (1) control of communicable and certain noninfectious diseases; (2) environmental engineering planning and impact analysis; (3) water supply; (4) wastewater treatment and disposal; (5) solid waste management; (6) air pollution and noise control; (7) radiation uses and protection; (8) food protection; (9) recreation areas and temporary residences; (10) vector and weed control and pesticide use; (11) the residential and institutional environment; and (12) administration. (Lantz-PTT)
W88-01659

WASTES IN MARINE ENVIRONMENTS,
Office of Technology Assessment, Washington, DC.
For primary bibliographic entry see Field 2L.
W88-01667

LAND TREATMENT EXAMPLE OF AN INTEGRATED MANAGEMENT SYSTEM,
Sheaffer and Roland, Inc., Chicago, IL.
For primary bibliographic entry see Field 5E.
W88-01729

PRETREATMENT AND LAND DISPOSAL OF INDUSTRIAL WASTE,
Cross/Tessitor and Associates, Orlando, FL.
For primary bibliographic entry see Field 5E.
W88-01732

BALING: A CASE STUDY,
Antigo City Engineer, WI.
For primary bibliographic entry see Field 5E.
W88-01757

MOLECULAR AND MARCOMOLECULAR SIEVING BY ASYMMETRIC ULTRAFILTRATION MEMBRANES,
Stanford Univ., CA. Dept. of Chemical Engineering.
C. R. Robertson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB85 157766/AS. Price codes: A14 in paper copy, A01 in microfiche. Completion Report, Sept. 1984. 295 p, 87 fig, 31 tab. Contract No. 14-34-0001-8548. Project No. BuRec C-80292-S (1).

Descriptors: *Ultrafiltration, *Membrane processes, Saccharides, Adsorption, Semipermeable membranes.

The sieving of dilute solutions of low molecular weight saccharides, proteins, and a polysaccharide, dextran, by several asymmetric ultrafiltration membranes has been studied principally as a function of transmembrane pressure drop or solvent flux J sub v in a stirred cell device. Scanning or transmission electron microscopy were used to examine the skin layer and substructure of each membrane. For each solute/membrane system studied, solute adsorption to the ultrafilter was not apparent, and solute sizes were characterized by Stokes-Einstein hydrodynamic radii. For polydisperse dextrans, gel permeation chromatography of filtrate and retentate solutions was used to determine the observed rejection coefficients, or fractional retention, of specific dextran mixture components. Concentration polarization, or the accumulation of retained solutes at the membrane surface can mask membrane behavior; accordingly, the flow patterns and specific mass transfer characteristics of the Amicon 52 stirred cell were studied under the turbulent flow conditions employed in all experiments. A one-dimensional mass transfer model was found adequate to describe the boundary layer concentration polarization, thereby permitting the intrinsic membrane rejection coefficient (R) to be related to the experimentally measured rejection coefficient. For a polyelectrolyts complex UM10 membrane (Amicon), R for each saccharide increased steadily with increasing J sub v in accord with the phenomenological Spieglar-Kadem two-parameter model of solute convection and diffusion through reverse-osmosis membranes. In macromolecular ultrafiltration with the cellulosic YM30 or Dynel XM50 and XM100 membranes, the variation in R with J sub v could also be described by a convection/diffusion membrane transport model; however, a slight decline in R at high J sub v was noted for dextrans with the XM membranes. Using an isoporous cylindrical pore model and the dextran transport parameters, the YM30, XM50, and XM100 membranes can be characterized by effective pore radii of 46, 85, and 126 A, respectively. Finally physical interactions between dextrans dissimilar in size were observed only in the presence of a high molecular weight totally retained dextran under 'gel' polarization conditions. (Robertson-Stanford)
W88-01771

SYSTEM AND METHOD FOR DISPOSAL OF NONCONDENSABLE GASES FROM GEOTHERMAL WELLS,
For primary bibliographic entry see Field 5E.
W88-01780

METHOD OF PRODUCING ULTRAPURE, PYROGEN-FREE WATER,
For primary bibliographic entry see Field 5F.
W88-01794

PROCESS AND APPARATUS FOR RECOVERING USABLE WATER AND OTHER MATERIALS FROM OIL FIELD MUD/WASTE PITS,
Romec Environmental Research and Development, Inc., College Station, TX.
R. J. O'Connor.
U.S. Patent No. 4,366,063 December 28, 1982. 7 p, 3 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1025, No 4, p 1423-1424, December 28, 1982.

Descriptors: *Patents, *Wastewater treatment, *Water reuse, *Oil wastes, *Reclaimed water, *Reverse osmosis, *Separation techniques, Oil recovery, Hydrocarbons, Salts, Mud, Drilling, Potable water, Filtration, Adsorption, Brine disposal, Waste recovery.

Useful water and other materials are recovered from oil field mud and waste pits containing solids, hydrocarbons, and salts. Solids are filtered from the water mixture to recover a waste stream containing the hydrocarbons and salt impurities. The water mixture is either pumped or drawn through an immersible filter in the container holding the water mixture. The container can be either a tank or the mud/waste pit itself. Separation of the hydrocarbons from the water stream produces a hydrocarbon stream and a water stream, which contains sodium an potassium chloride impurities. The water stream is passed to a filtering and adsorption system to remove remaining particulates and residual hydrocarbons. The stream is then introduced under pressure into a reverse osmosis unit for recovery of a useful water stream and a concentrated brine stream of substantially less volume for disposal. (Cremmins-AEPCO)
W88-01795

APPLICATION OF SOLAR ENERGY IN WATER REUSE,
Banaras Hindu Univ., Varanasi (India). Pollution Research Lab.
G. Prasad.
Journal of Chemical Technology and Biotechnology JCTBDC, Vol. 39, No. 1, p 29-36, 1987. 3 fig, 3 tab, 15 ref.

Descriptors: *Wastewater treatment, *Oxidation, *Fly ash, *Solar energy, *Economic aspects, *Wastewater renovation, *Water reuse, Chlorination, Ozonation, Ultraviolet radiation, Bacteria, Dissolved solids, Adsorption, Disinfection.

The application of photocatalyzed oxidation in water reuse technology is described. Results with a sequencing batch reactor showed that 4 hours contact of the raw sewage with 0.5 mg dye sorbed per g fly ash in sunlight, under experimental conditions, significantly reduced the organic and bacteriological load and rendered it fit for use in irrigation or for discharge. Effects of variables such as contact time or amount of dye sorbed on COD, MBAS, and MPN counts were investigated and the results interpreted in terms of enhanced photoactivity and biodegradation in the sorbed state. The process appears to be well suited to commercial exploitation as it is safe, quick and economical. (Author's abstract)
W88-01807

APPLICATION OF A SUSPENSION-AIRLIFT-LOOP-REACTOR TO THE PURIFICATION OF DIFFICULT WASTEWATER (EINSATZ EINES SUSPENSIONS-AIRLIFT-SCHLAUFEN REAKTORS ZUR REINIGUNG PROBLEMATISCHER ABWAESSER),
Gesamthochschule Paderborn (Germany, F.R.). Fachbereich 13 - Chemie und Chemietechnik.
R. J. Becker, P. Hueppe, K. Wagner, and D. C. Hempel.
Chemieingenieurtechnik CITEAH, Vol. 59, No. 6, p 486-489, 1987. 4 fig, 1 tab, 11 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Biological wastewater treatment, *Sulfonates, Sand, Bacteria, Pseudomonas, Activated sludge, Biodegradation.

Design and experimental operation are discussed for a reactor that immobilizes active bacteria on fluidized sand. In the experimental model, quartz sand with a diameter of 212 micrometers was used for the degradation of naphthalene-2-sulfonic acid using Pseudomonas testosteroni. Despite variations in the biomass concentration, the degree of degradation remained above 96%. Flow rates during these trials were varied. After substrate interruption of several hours, the culture was able to reach maximal digestion capability within 2 days at most. The reactor has only a small space requirement and can be readily integrated into existing systems. (Airone-PTT)
W88-01814

MONITORING METHODS ASSESSED FOR POWER PLANT WASTE STREAMS,
Electric Power Research Inst., Palo Alto, CA.
W. Chow, and R. Maddalone.
Power Engineering POENDL, Vol. 91, No. 6, p 42-45, June 1987. 4 fig.

Descriptors: *Water quality control, *Wastewater treatment, *Chemical analysis, *Electric powerplants, Detection limits, Precision, Trace metals, Regulations, Heavy metals, Water quality, Reproducibility, Industrial wastewater, Monitoring.

TRW, Inc. has assessed the applicability of EPA-approved analytical methods by comparing EPA-quoted LODs (limits of detection) for a range of pollutants to the LODs actually achievable in utility laboratories. Since power plant samples are not taken under laboratory conditions as EPA tests are, EPA-quoted limits of detection may not be reachable, even when using EPA-approved analytical methods. The assessment project, funded by EPRI, consisted of both a literature review and a series of field studies. Effluent data were collected from industry, government, and from outside sources. Data were also collected on precision,

bias, and interference. TRW was able to determine LODs for both single-operator (within laboratory) and overall (between labs) data. Comparison showed that the EPA-quoted LODs were in some cases at least an order of magnitude too low. Precision data results suggest strongly that EPA LODs for utility wastewaters should reflect the effects of interferences on wastewater streams. Bias data results suggest that EPA approved analytical methods can accurately monitor most utility freshwater streams for concentration levels that can realistically be detected. However, utility labs monitoring TCMCW (treated chemical metal cleaning wastes) or other streams containing high levels of organic or inorganic materials should be aware that interferences in the makeup of a given wastewater can significantly effect results. The reference data produced by this project should help utilities determine what degree of bias in element concentration readings can be expected based on a given waste stream's characteristics. (Airone-PTT)
W88-01815

PERFORMANCE OF A NATURAL WETLAND TREATMENT SYSTEM FOR WASTEWATER MANAGEMENT,
CH2M Hill, Inc., Gainesville, FL.
R. L. Knight, T. W. McKim, and H. R. Kohl.
Water Pollution Control Federation. Journal JWPFA5, Vol. 59, No. 8, p 746-754, August 1987. 7 fig, 4 tab, 13 ref.

Descriptors: *Wastewater management, *Wetlands, Nitrogen, Phosphorus, Pollution load, Seasonal variation, Dissolved solids, Wastewater disposal, Biological oxygen demand, Suspended solids.

Nearly 9 years (October 1978 to date) of water quality and quantity data exist from the Reedy Creek wetland system for annual average wastewater flows varying from 6,050 to 14,760 cu m/d. This wetland is located in the Walt Disney World Resort Complex in Florida and is the largest full-scale forested wetland effluent discharge system that has been extensively monitored in the U.S. The intent of this paper is to present a summary of the hydrological and chemical data available from the RCID wetland system for the period through December 1985, with an analysis of empirical engineering design principles for application to the design of other NWT (natural wetland treatment) systems. Mass balances indicated significant removal of BOD sub 5, total suspended solids (TSS), and total nitrogen (TN). The mass balance for total phosphorus (TP) demonstrated a net increase in the mass of phosphorus between the inflow and outflow points of the wetland, apparently attributable to stormwater inflows. Removal rate is significantly correlated with loading rate for BOD sub 5, TSS, and TN. Removal efficiency does not decrease for these constituents at the highest loadings observed (approximately 0.522 to 1.351 g/sq m/d). Removal rate drops off at low mass loading rates for BOD sub 5 and TSS. There was no significant reduction of constituent removal rates over a range of average monthly water temperatures (10-25 C). Residence time seems to be a key ingredient in the mix of treatment mechanisms in a NWT system. Residence time appears to be the primary causative factor influencing TP removal rate. (Airone-PTT)
W88-01822

TOTAL ORGANIC HALOGEN (TOX) FORMATION POTENTIALS IN ACTIVATED SLUDGE TREATMENT AND SMALL RIVERS,
Tokyo Univ. (Japan). Dept. of Urban Engineering.
N. Suzuki, and J. Nakanishi.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 8, p 767-773, August 1987. 7 fig, 8 tab, 12 ref.

Descriptors: *Water treatment, *Activated sludge, *Wastewater treatment, *Water quality control, *Chlorinated hydrocarbons, Chlorination, Biological oxygen demand, Self-purification, Halogens, Chloroform, Biological wastewater treatment, Drinking water, Organic carbon, Water quality standards.

Trihalomethanes (THMs) and other various chlorinated organic compounds are formed during drinking water chlorination. Most of the total organic halogens (TOX) other than THMs are nonvolatile and show stronger mutagenic activities than the volatiles. Health concerns over chlorination should therefore include non-volatile TOX portions as well. In this study, TOX formation potential (TOXFP) is used instead of BOD to assess drinking water quality. TOXFP would make reasonable planning possible concerning wastewater treatment, drinking water purification, and river water quality control. TOXFP was measured with a high chlorine dose, but TOXFP associated with a lower, conventional dose was measured as well for comparison. Studies were conducted at the Machida wastewater treatment plant (80 000 cu m/d capacity). Self-purification processes were studied at Sakaigawa and Tagawa Rivers. Removal efficiency for TOX-200 (high chlorine dose) was 89% and that for TOX-10 (lower chlorine dose) was 86% in the activated sludge wastewater treatment plant. These efficiencies were lower than that of BOD (97%) and TOC (92%). A decrease in TOXFP loadings by self-purification was also observed at small rivers, whereas the deoxygenation rate constant for TOX-200 was about one-fourth of that for BOD. TOXFP/TOC ratios tended to increase with the progress of the activated sludge treatment process or river self-purification process. Therefore, the effects of pollution from the upstream area might be underestimated, when BOD or TOC indexes are used instead of TOXFP. The TOXFP index could be applied to the refinement of drinking water systems, especially when the artificial contamination of resource water has occurred. (Airone-PTT)
W88-01825

LAND APPLICATION OF SLUDGE IN SAN DIEGO,
Nolte (George S.) and Associates, Sacramento, CA.
For primary bibliographic entry see Field 5E.
W88-01826

INFLUENCE OF PHOTOREACTIVATION AND WATER QUALITY ON ULTRAVIOLET DISINFECTION OF SECONDARY MUNICIPAL WASTEWATER,
Utah State Univ., Logan. Div. of Environmental Engineering.
G. D. Harris, V. D. Adams, D. L. Sorensen, and R. R. Dupont.
Water Pollution Control Federation JWPFA5, Vol. 59, No. 8, p 781-787, August 1987. 9 fig, 3 tab, 31 ref.

Descriptors: *Ultraviolet radiation, *Wastewater treatment, *Secondary wastewater treatment, *Hyrum, *Utah, Disinfection, Chlorination, Municipal wastewater, Coliforms, Water quality standards, Bacteria, Biological oxygen demand, Organic carbon.

A nine-month field and laboratory study of UV disinfection was conducted at the Hyrum Municipal Wastewater Treatment Plan, Hyrum, Utah. The Hyrum plant is a 3800 cu m/d (1-mgd) secondary treatment plant and currently disinfects with chlorine. Disinfection by chlorination produces residuals which are toxic to aquatic organisms and may cause the formation of carcinogenic compounds. Currently, UV disinfection of secondary wastewater is recognized as a viable alternative. One objective of this study was to compare the performances of a quartz-sleeve and a polytetrafluoroethylene (PTFE) tube design UV reactor. A second objective was to correlate commonly measured water quality parameters with reactor efficiency (i.e., bacterial survival rates) and UV absorbance using field and laboratory data collected over the study period. A third objective was to determine a potential for photoreactivation of indicator bacteria in disinfected wastewater. The effluent that was disinfected in this study was characterized by a wider range of water quality than the actual effluent from the plant. As regards photoreactivation, disinfection efficiency of the total coliform and fecal coliform groups decreased significantly, particularly in the quartz-sleeve reactor (2.0 log reactivations as opposed to 0.5 for the PTFE-tube reactor). There was little evidence of fecal streptococci photoreactivation in either system. Highly significant correlations existed between suspended solids, fecal coliform survival and UV absorbance at 254 nm. Turbidity was concluded to be a good surrogate measure of the disinfection efficiency and the UV absorbance of the Hyrum Plant effluent. Other commonly measured parameters which showed significant correlation with fecal coliform survival and UV absorbance included total BOD, inhibited BOD and TOC. Though unit costs of UV disinfection were high, suggested improvements could reduce these costs by up to 50%. (Airone-PTT)
W88-01827

TWO-STAGE CYCLIC OPERATION OF ANAEROBIC FILTERS,
Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
D. E. Howerton, and J. C. Young.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 8, p 788-794, August 1987. 6 fig, 5 tab, 10 ref. US EPA Research grant R-810528010.

Descriptors: *Wastewater treatment, *Anaerobic digestion, Performance evaluation, Costs, Industrial wastes, Methane, Sludge disposal, Filtration, Chemical oxygen demand.

The need to pretreat industrial wastes has generated considerable interest recently in the development and economical application of anaerobic systems. The performance of the two-stage cyclic operation is compared here with that of single stage units operated at equal volumetric organic loadings; individual response of the two stages immediately following stage reversal is also evaluated. The two-stage cyclic mode of anaerobic filter operation showed improvement in COD removal compared to single-stage unit performance (8% at 4 kg/cu m/d and 11% at 8 kg/cu m/d). The staged reactors readily accepted the reversals without loss of overall efficiency or gas production. While the required use of two reactors may increase capital costs as compared to one reactor, the absence of the need for polishing units and their high operating costs should provide a system of overall lower cost. Some questions remain concerning performance characteristics of the cyclic process, and these are discussed. (Airone-PTT)
W88-01828

MICROBIAL GROWTH ON ION EXCHANGERS,
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergutewirtschaft und Abfalltechnik.
H. C. Flemming.
Water Research WATRAG, Vol. 21, No. 7, p 745-756, July 1987. 32 ref.

Descriptors: *Wastewater treatment, *Ion exchange, *Microbiological studies, Adsorption, Resins, Silver, Disinfection, Bacteria, Regeneration.

Bacteria in ion exchange resin beds find enough organic material to live on such as adsorbed matter from the water passing through as well as substances which may be released from the resin material. They settle on the outer surface of the resin material but are not securely attached. Nevertheless, contaminated exchangers cannot be sanitized by flushing, backflushing or other rinsing processes. Regeneration removes a part of the microbial population but is not sufficient for sanitation. If exchange units can be left standing in the regenerant during off-periods, the bactericidal effect can be utilized. A continuous mode of operation prevents bacterial growth to a certain extent. Recirculation during off-periods acts as a fermentation process and cannot prevent bacterial growth. Addition of silver suppresses bacterial growth for the period of time elapsing until a silver-tolerant population has developed. An increase in silver tolerance takes place when the population is exposed to sub-toxic silver concentrations. Satisfactory disin-

fection can be carried out with peracetic acid (0.01%, 1 h). A remanant effect can be produced by combination of silver conservation with peracetic acid disinfection based on the period of time needed for the development of silver tolerance by the bacterial flora on the ion exchanger. Ion exchange units must be subjected to routine bacterial monitoring in all cases where hygienic implications are involved with their usage. (Author's abstract)
W88-01834

METHOD FOR EVALUATING THE MIXING CHARACTERISTICS OF U.V. REACTORS WITH SHORT DETENTION TIMES,
Texas Univ. at Austin. Dept. of Civil Engineering.
M. V. Thampi, and C. A. Sorber.
Water Research WATRAG, Vol. 21, No. 7 p 765-771, July 1987. 5 fig, 4 tab, 14 ref.

Descriptors: *Mixing, *Wastewater treatment, *Ultraviolet radiation, Disinfection, Salt tracers, Model studies, Hydraulic models, Permeability coefficient, Mathematical studies, Flow profiles.

Ultraviolet (u.v.) light disinfection of municipal wastewaters is rapidly gaining popularity as an alternative to chlorination. However, little information is available which correlates the disinfection efficiencies with the various types of u.v. reactor system designs. The results of research carried out on a particular u.v. reactor design: a Teflon-tube wastewater carrier externally irradiated by a parallel u.v. lamp are presented. An experimental method was developed to obtain concentration-time distribution curves for reactors of detention times of <5 s, the salt-tracer conductivity bridge-cell. Flow parameters for various flow rates were calculated from these curves. The results suggest that it is possible to develop mathematical models which incorporate flow parameters to predict u.v. disinfection in this system. (Author's abstract)
W88-01836

FLUORINE POLLUTION IN THE MARMARA REGION, TURKEY. PRODUCTION METHODS FOR FLUORINE REMOVAL AND RECOVERY,
Temel Bilimler Arastirma Enstitusu, Gebze (Turkey). Chemical Engineering Dept.
N. Altinatas, T. Ayok, and T. Gozmen.
Water Research WATRAG, Vol. 21, No. 7, p 781-788, July 1987. 6 fig, 7 tab, 22 ref.

Descriptors: *Wastewater treatment, *Fluorine, *Turkey, *Chemical wastewater, Fluorides, Fertilizers, Industrial wastewater, Calcium fluoride, Sodium fluosilicate, Fluosilicic acid.

The importance of the removal and recovery of fluorine from Turkish fertilizer plant effluents is emphasized. Even though the economic evaluation of the processes developed are not based on capital and operating costs for the processes, there are strong economic incentives to adopt recovery apart from clear environmental needs. Selection of the methods for the removal of fluorine through production processes, specifically the dependence of the choice of waste treatment process on available H2SiF6 concentration, is discussed. The production of acid grade calcium fluoride and sodium fluosilicate from waste fluosilicic acid solutions were studied. The optimum process conditions were determined. It has been found that it is possible to produce these industrially valuable fluorine compounds from 2.5 to 4.5% H2SiF6 containing waste waters and in appropriate conditions both processes are effective in removing 90-95% of the fluorine present in waste fluosilicic acid solutions. For the production of acid grade calcium fluoride and sodium fluosilicate the p2O5 content of waste fluosilicic acid solutions should be <250 mg P2O5/L and 300 mg P2O5/L respectively. It is suggested that pilot plant studies be conducted for the industrial application of the process. (Author's abstract)
W88-01838

CULTIVATION OF ANAEROBIC GRANULAR SLUDGE IN UASB REACTORS WITH AEROBIC ACTIVATED SLUDGE AS SEED,
Tsinghua Univ., Beijing (China). Dept. of Environmental Engineering.
W. Wu, J. Hu, X. Gu, Y. Zhao, and H. Zhang.
Water Research WATRAG, Vol. 21, No. 7, p 789-799, July 1987. 8 fig, 5 tab, 35 ref.

Descriptors: *Anaerobic digestion, *Sludge digestion, *Activated sludge, *Wastewater treatment, Methanogenic bacteria, Aeration, Chemical oxygen demand.

Methanogenic bacteria of 10 to the 8th power gm/SS in the activated sludges from an aeration tank treating sewage and from a secondary sedimentation tank of an activated sludge plant treating textile dyeing wastewater were enumerated by the Most Probable Number (MPN) technique. By using the two activated sludges as the seed material, anaerobic granular sludges were obtained at 35 C in two lab-UASB reactors having volumes of 29 and 48 L, and treating a glucose molasses solution of 1000-3500 mg COD/L and citrate wastewater of 20,000-36,000 mg COD/L respectively. The characteristics of granulation using the activated sludge as the seed were similar to those using digested sewage sludge as the seed. It is shown that activated sludge is a readily available seed material for an anaerobic reactor. The growth of methanogenic bacteria in the activated sludge can be attributed to the existence of some anaerobic nuclei in the activated sludge flocs. The factors for the cultivation of granular sludge by using the activated sludge include characteristics of the wastewater, operational variables (COD loading rate, hydraulic loading rate, etc.), environmental factors (pH, temperature, nutrient requirements, characteristics and amount of seed material. (Lantz-PTT)
W88-01839

EFFECT OF OZONE ON PLASMID DNA OF ESCHERICHIA COLI IN SITU,
Government Industrial Development Lab., Sapporo (Japan).
For primary bibliographic entry see Field 5F.
W88-01843

CONTROL OF BULKING SLUDGES: FROM THE EARLY INNOVATORS TO CURRENT PRACTICE,
Enviro Enterprises, Inc., Salt Lake City, UT.
R. E. Albertson.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 4, p 172-182, April 1987. 6 fig, 5 tab, 37 ref.

Descriptors: *Bulking sludge, *Wastewater treatment, Dissolved oxygen, Sludge volume index, Sludge density index, Aerobic digestion, Anaerobic digestion, Suspended solids.

Sludge bulking in activated sludge systems has plagued designers and users from the early stages of developing the continuous mode process. It is now evident that the problem of bulking sludge emerged concurrently with the evolution of the activated sludge reactor design from draw-and-fill or batch reactors to continuous flow designs. Lacking a comparative measure of the sludge settling characteristics, such as sludge volume index (SVI) or sludge density index (SDI), early practitioners and researchers referred instead to what is now recognized as bulking sludge as the instability of the process or the unsettleability of the sludge. Bulking of sludge is encountered at low diasolved oxygen (DO), high Do, low food-to-microorganism (F:M) ratio, high F:M substrate composition, and low pH, and it is influenced by a host of other possibilities including reactor configuration. Four major biological control practices for reducing the probability of producing a bulking sludge are used today. They are: (1) the use of very long plug-flow reactors (PFR) or folded basins to minimize backmixing as well as to control DO in the initial zones; (2) The compartmentalization of a biological reactor into a series of reaction vessels to eliminate back-mixing. This practice assures a high to low F:M gradient throughout the series of compartments in the reactor; (3) The operation of the first zone of a compartmentalized reactor in a fully aerobic (> or = 2 mg/L DO) environment or in an oxygen deficient (< or = 0.2 mg/L DO) condition both operating at high F:M loadings; and (4) The use of sequencing batch reactor (SBR) where the reactor is filled without air addition. (Lantz-PTT)
W88-01850

EVALUATION OF ACTIVATED BIOFILTRATION AND ACTIVATED BIOFILTRATION/ACTIVATED SLUDGE TECHNOLOGIES,
Montgomery (James M.), Inc., Pasadena, CA.
M. L. Arora, and M. B. Umphres.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 4, p 183-190, April 1987. 6 fig, 3 tab, 18 ref. EPA Contract No. 68-03-1821.

Descriptors: *Wastewater treatment, *Biofiltration, *Activated sludge, Design standards, Evaluation, Sludge, Biochemical oxygen demand, Aeration, Costs.

A review and investigation of the activated biofilter (ABF) and activated biofilter/activated sludge (ABF/AS) technologies was conducted. This included a review of the manufacturer's patent, design brochures, and literature as well as operating records of 19 municipal wastewater treatment plants. Site visits were made to two plants. Sludge and biofilter effluent recycle inherent in the ABF/AS process make the system difficult to analyze. In particular, biochemical oxygen demand (BOD) removal across the biofilter cannot be measured accurately. Consequently, the approach to design of the aeration basin and associated equipment has not been uniform among practicing engineers, who have designed these systems. However, ease of operation, reliability, and potential economic advantages over continental AS make it a system worthy of consideration. (Author's abstract)
W88-01851

REMOVAL OF HAZARDOUS ORGANIC POLLUTANTS BY BIOMASS ADSORPTION,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
J. P. Bell, and M. Tsezos.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 4, p 191-198, April 1987. 8 fig, 4 tab, 30 ref.

Descriptors: *Wastewater treatment, *Organic wastes, *Biomass, *Adsorption, Organic compounds, Lindane, Diazinon, Malathion, Pentachlorophenol, Polychlorinated biphenyls, Thermodynamics, Biological degradation, Pesticides.

Removal of five toxic organic compounds from water by adsorption on microbial biomass was investigated. Lindane, diazinon, malathion, pentachlorophenol, and the PCB 2-chlorobiphenyl were absorbed onto two types of inactive microbial biomass (a pure strain of Rhizopus arrhizus, and a mixed culture of activated sludge). Desorption and the thermodynamics of the adsorption process were also investigated. With the exception of malathion, the adsorptive uptake data fit the Freundlich equation and were well correlated with the octanol/water coefficient, but not as well correlated with water solubility of the compounds. Except for malathion, the adsorption was reversible. Malathion showed unusually high apparent uptake and the removal appeared to be irreversible. The experimental evidence suggests that the disappearance of malathion resulted from a chemical reaction, while physical adsorption appears to account for removal of the other compounds. (Author's abstract)
W88-01852

NITRIFICATION ENHANCEMENT IN THE POWDERED ACTIVATED CARBON-ACTIVATED SLUDGE PROCESS FOR THE TREATMENT OF PETROLEUM REFINERY WASTEWATERS,
Argonne National Lab., IL. Energy and Environmental Systems Div.
A. Ng, M. K. Stenstrom, and D. R. Marrs.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 4, p 199-211, April 1987. 15

fig, 8 tab, 36 ref, NSF Grant No. CEE 7911792.

Descriptors: *Nitrification, *Wastewater treatment, *Activated carbon, *Activated sludge, *Oil industry, *Industrial wastes, Ammonia, Oil wastes, Adsorption.

Powdered activated carbon (PAC) can be added to activated sludge processes with a variety of potential benefits. Improved ammonia removal is an unexpected benefit because ammonia is normally not adsorbed by activated carbon. To investigate the mechanism of improved ammonia removal, a series of batch and continuous experiments were conducted on synthetic and petroleum refinery wastewaters. Petroleum refinery wastewater was selected because it is often difficult to nitrify. Results suggest that adsorption of nitrification-inhibiting compounds is the primary mechanism; no evidence of improved nitrifier growth caused by the presence of increased suspended solids was found. The results also suggest that heterotrophic acclimation to the nitrification inhibitors, resulting in improved inhibitor removal, is as important to continued high nitrification efficiency as PAC addition in low concentration. (Author's abstract)
W88-01853

KINETICS OF DOWNFLOW ANAEROBIC ATTACHED GROWTH REACTORS,
National Research Council of Canada, Ottawa (Ontario).
K. H. Kennedy, M. F. Hamoda, and R. L. Droste.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 4, p 212-221, April 1987. 9 fig, 6 tab, 27 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Kinetics, Biofilm, Industrial wastewater, Suspended solids, Retention time, Biomass, Model studies, Mathematical models, Carbohydrates.

Anaerobic downflow stationary biofilm reactors operated at 35 C successfully treated different synthetic (carbohydrate based and short chain volatile acid based) wastewaters of different concentrations at high organic loading rates and short hydraulic retention times. Based on observed relations between solids retention time, hydraulic retention time, and loading rate, an empirical model based on Monod kinetics was formulated for the process using these two very different wastewaters. Incorporation of a washout factor into accepted theory allowed good prediction of chemical oxygen demand removal efficiency and reactor biomass concentrations. (Author's abstract)
W88-01854

DESIGN, OPERATIONAL, AND COST CONSIDERATIONS FOR VACUUM ASSISTED SLUDGE DEWATERING BED SYSTEMS,
Montgomery (James M.), Inc., Pasadena, CA.
A. J. Condren, A. T. Wallace, I. A. Cooper, and J. F. Kreisl.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 4, p 228-234, April 1987. 2 fig, 11 tab.

Descriptors: *Wastewater treatment, *Vacuum assisted sludge dewatering bed, *Costs, *Design standards, Sludge drying, Sludge bed, Dewatering, Sludge solids.

The vacuum assisted sludge dewatering bed (VASDV) process developed in the mid-1970s incorporates the application of a vacuum to the underside of a rigid, porous plate grid system on which chemically conditioned sludge has been placed. The vacuum pulls free water through the media plates while the plate system acts as a septum to retain essentially all of the sludge solids. An initial gravity drainage time interval used to remove a portion of the free water through the media plates begins as soon as conditioned sludge is introduced and normally continues for 1-3 hours. After this free drainage period, the vacuum pump activates to mechanically assist removal of additional free water. Upon completion of the vacuum-assisted free water removal cycle and an optional air drying time interval, the partially dewatered sludge is removed, usually with a front-end loader. Next, the plate system is cleaned by rinsing residual sludge solids from the upper surface of the media plates with high pressure water. After this surface cleaning, the system is ready for another application of chemically conditioned sludge. The findings of post-construction evaluations of 12 operational VASDB systems located at municipal wastewater treatment facilities throughout the U.S. are summarized. These systems dewatered aerobically and anaerobically digested sludges, undigested secondary sludge from extended aeration and oxidation ditch plants, a mixture of undigested secondary sludge and phosphate precipitation (alum) sludge, Imhoff tank sludge and a lime-conditioned mixture of undigested primary and secondary sludges. An approximately equal number of the three available VASDB systems were also evaluated. Data and information contained in this article include: existing facility design, operational and cost data; and suggested improvements to current design and operational practices. This evaluation indicates that this technology is an acceptable and cost-effective alternative to more conventional sludge dewatering processes used at small- to medium-sized wastewater treatment facilities. (Lantz-PTT)
W88-01856

EFFECTIVENESS OF LIME-BASED AMENDMENTS AND BAUXITE RESIDUES AT REMOVING PHOSPHORUS FROM PIGGERY EFFLUENT,
Western Australia Univ., Nedlands. Dept. of Soil Science and Plant Nutrition.
D. M. Weaver, and G. S. P. Ritchie.
Environmental Pollution EPEBD7, Vol. 46, No. 3, p 163-175, 1987. 7 fig, 2 tab, 10 ref.

Descriptors: *Farm wastes, *Swine, *Wastewater treatment, *Phosphorus, *Bauxite, *Lime, Eutrophication, Red muds, Kiln dust, Clarification, Flocculation, Hydrogen ion concentration.

Piggery effluent may contribute to the eutrophication of waterways if it is not treated before disposal because of high levels of phosphorus. Limes and red muds (a residue from bauxite refining) were used to remove phosphorus from piggery effluent (41 mg/L total P). Lime-based amendments were more effective than the red muds at removing phosphorus when compared at the same liquid:solid ratios. Based on laboratory data, the cost of treating effluent increased rapidly as the final required phosphorus concentration decreased to less than 4 mg/L. Kiln dust was the cheapest amendment tested down to 2 mg/L. Hydrated lime was able to clarify and flocculate the effluent to 1 mg/L within 60 min. The reusability of all limes may be determined by a simple pH test. Red mud could be used to remove phosphorus when its pH was lowered to 6.0-6.5 and it is used at liquid:solid ratios <20:1. (Author's abstract)
W88-01861

APPLICATION OF PARTIAL LEAST-SQUARES MODELLING IN THE OPTIMIZATION OF A WASTE-WATER TREATMENT PLANT,
Lappeenrannan Teknillinen Korkeakoulu (Finland).
P. Aarnio, and P. Minkkinen.
Analytica Chimica Acta ACACAM, Vol. 191, p 457-460, December 31, 1986. 4 fig, 2 tab.

Descriptors: *Partial least-squares method, *Statistical models, *Least squares method, *Wastewater treatment facilities, Bulking sludge, Statistical methods, Municipal wastewater, Temperature, Carbon, Phosphorus.

The partial least-squares (PLS) method was applied to data collected at a municipal wastewater treatment plant to estimate the relationship between the process parameters and effluent quality. The main reason for poor treatment efficiency was the so-called bulking phenomenon of the activated sludge. The PLS model of the data representing a normal period of operation and the bulking period thereafter showed that high temperature and decreasing concentrations of carbon and phosphorus contributed to the bulking state. The concentration of phosphorus and the chemical oxygen demand after primary sedimentation should be kept above 3 mg/L and 40 mg/L, respectively. (Lantz-PTT)
W88-01869

ECONOMIC AND ENVIRONMENTAL BENEFITS FROM FROTH FLOTATION RECOVERY OF TITANIUM, ZIRCONIUM, IRON AND RARE EARTH MINERALS FROM OILS AND TAILINGS,
University of Western Ontario, London. Dept. of Chemical and Biochemical Engineering.
M. T. Ityokumbul, W. Bulani, and N. Kosaric.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 323-331, 1987. 3 fig, 5 tab, 23 ref.

Descriptors: *Wastewater treatment, *Flotation, *Waste recovery, *Froth flotation recovery, *Heavy metals, *Oil wastes, *Economic aspects, Industrial wastes, Titanium, Zirconium, Iron, Rare earth minerals, Oilsand tailings, Costs, Cost analysis, Cost-benefit analysis, Recycling, Canada.

The froth flotation recovery process for heavy minerals from oilsand tailings which involves recovery of iron and rare earth minerals along with titanium and zirconium minerals was developed. The recovery of rare earth mineral value from these tailings has not been reported previously due to their low concentrations. Preliminary cost evaluations of these processes show that revenue from the minerals recovered from the centrifuge tailings of an oilsand plant in Alberta, Canada, employing the hot water extraction process can make environmentally sound tailings treatment and disposal an economically viable operation; the value of the recovered minerals was estimated to be almost double the cost of full effective tailings management. Adoption of these processes can eliminate the current unsound practice of simply storing these tailings behind high dikes in large lagoons. (Wood-PTT)
W88-01927

EXAMINATION OF THE ZINC CEMENTATION OF CADMIUM IN AQUEOUS SOLUTIONS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
J. P. Gould, I. B. Escovar, and B. M. Khudenko.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 333-344, 1987. 14 fig, 1 tab, 12 ref.

Descriptors: *Wastewater treatment, *Zinc, *Cadmium cementation, *Aqueous solutions, *Chemical reactions, Industrial wastewater, Cadmium, Fate of pollutants, Heavy metals, Kinetics, Hazardous materials, Toxins, Wastewater, Industrial wastewater, Model studies.

The kinetics of the cementation of cadmium by zinc were studied over a range of solution pH values and initial cadmium concentrations. The kinetics were interpreted in terms of a model postulating a transition from a migration controlled mechanism with consequent half order kinetics to a diffusion controlled regime following first order kinetics. The conditions under which each mechanism was found to apply were consistent with the model in which the immediate reductant was hydride ion generated by the interaction of hydrogen ions with the zinc. The reaction stoichiometry was remarkable in that conditions were observed under which more than the theoretical one mole of cadmium per mole of zinc could be reduced. This was ascribed to the electrolysis of water by the induced electrochemical system. A lag in both cadmium cementation and zinc dissolution was found to commence about 25% sooner than cadmium cementation, a fact ascribed to the establishment of the reducing electrochemical system. (Author's abstract)
W88-01928

BIOLOGICAL TREATMENT FOR LOW-ACTIVITY NUCLEAR WASTEWATERS,
Istituto di Ricerca sulle Acque, Rome (Italy).
R. Ramadori, F. Fenoglio, and L. Pozzi.

Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 345-353, 1987. 2 fig, 4 tab, 4 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Radioactive wastes, Sol-Gel process, Denitrification, Nitrates, Design criteria, Industrial wastewater, Uranium, Plutonium, Hazardous materials, Kinetics.

A wastewater treatment process which can provide for a complete recycling of liquid streams for the nuclear industry was developed. The Sol-Gel process involves transformation of a solution of uranyl and plutonium nitrate into granules of uranium and plutonium oxides which pose fewer health hazards due to their normally larger-than-dust particle size. These granules do not remain in the air or stick to glove-box walls, and are freeflowing and therefore easily transportable during the formation of pellets. The results of bench-scale tests performed to evaluate dimensioning parameters for this biological denitrification process are reported. The Sol-Gel process consists of a Sol preparation obtained by adding a mixture of tetrahydrofuryl alcohol, the major organic compound in the wastewater as an electron-donor substance, and methocel to the nitrate solution. Adaptation of this procedure for full-scale plant design and the preliminary results obtained from its use are described. (Wood-PTT)
W88-01929

BIODEGRADATION OF OIL ON DRILLED CUTTINGS,

Rogalandsforskning, Stavanger (Norway).
T. Bilstad, T. Bosdal, and E. Toerneng.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 355-369, 1987. 15 fig, 8 tab, 3 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Oil wastes, *Biodegradation, Oil pollution, Industrial wastes, Petroleum products, Oil, Biological oxygen demand, Chromatography.

Drilled cuttings from offshore petroleum exploration are discarded to the sea. Oil-based drilling fluids leave oil on the cuttings that may become environmentally toxic. Successful biological separation of oil and cuttings was accomplished by addition of nitrogen and phosphorus to seawater in completely mixed aerobic batch reactors at 10 and 20 C. Substantial biodegradation in flow-through aquaria, however, was not accomplished. Both retort distillation and solvent extraction using dichloromethane in a Soxhlet apparatus separated reproducible quantities of hydrocarbons from cuttings. The oil was characterized by glass capillary gas chromatography and medium pressure liquid chromatography. (Author's abstract)
W88-01930

PHOTOCATALYSED OXIDATION OF TOXIC ORGANICS,

Tennessee Technological Univ., Cookeville. Center for the Management, Utilization and Protection of Water Resources.
M. B. Borup, and E. J. Middlebrooks.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 381-390, 1987. 7 fig, 2 tab, 16 ref.

Descriptors: *Photoactivation, *Wastewater treatment, *Oxidation, *Ultraviolet radiation, Organic compounds, Hydrogen peroxide, Isophorone, Dimethyl phthalate, Chemical reactions, Toxins, Hazardous materials.

The feasibility of treating water contaminated by two toxic organic compounds with an ultraviolet light catalyzed oxidation process using hydrogen peroxide as an oxidant is investigated. In this process hydrogen peroxide is decomposed by ultraviolet radiation producing hydroxyl radicals. The hydroxyl radicals then oxidize organic compounds via a complex chain of radical reactions. Tests showed that this photooxidation process could successfully remove isophorone and dimethyl phthalate from contaminated waters. A reaction rate expression which adequately describes the process was developed. The reaction rate was found to be first order with respect to hydrogen peroxide concentration, zero order with respect to organic concentration and a function of ultraviolet radiation intensity. The reaction did not exhibit autocatalytic characteristics. (Author's abstract)
W88-01932

STUDY ON THE USE OF BIPOLAR-PARTICLES-ELECTRODES IN DECOLORIZATION OF DYEING EFFLUENTS AND ITS PRINCIPLE,

Harbin Inst. of Tech. (China). Dept. of Applied Chemistry.
D. Zhou, W. M. Cai, and Q. H. Wang.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 391-400, 1987. 12 fig, 8 tab, 4 ref.

Descriptors: *Color removal, *Dye industry wastes, *Wastewater treatment, *Bipolar-particle-electrodes, Industrial wastes, Dyes, Color, Effluents, Chemical oxygen demand, Biological oxygen demand.

The use of bipolar-particle-electrodes in the decolorization of dying effluents was studied. Treatment of highly colored solutions of various soluble dyes (such as direct, reactive, cationic, or acid dyes) and also samples of dying effluents gave rise to an almost colorless, transparent liquid, with removal of COD and BOD5 surpassing 80%. The method is characterized by its high efficiency, low energy consumption and long performance life. This method combines all the advantages of the AC adsorption and electrolysis methods and is an improvement over the conventional electrolysis method. A discussion of the underlying principle is given. (Wood-PTT)
W88-01933

REMOVAL OF HAZARDOUS ORGANIC POLLUTANTS BY ADSORPTION ON MICROBIAL BIOMASS,

McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
J. P. Bell, and M. Tsezos.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 409-416, 1987. 5 fig, 5 tab, 10 ref.

Descriptors: *Biological wastewater treatment, *Wastewater treatment, *Adsorption, *Organic compounds, Hazardous materials, Biomass, Activated sludge, Mathematical equations, Freundlich equation, Correlation analysis, Lindane, Diazinon, Malathion, Pentachlorophenol, Polychlorinated biphenyls, Pesticides.

Removal of five toxic organic compounds from water by adsorption on microbial biomass was investigated. Lindane, diazinon, malathion, pentachlorophenol, and the PCB 2-chlorobiphenyl were adsorbed onto two types of inactive microbial biomass (a pure strain of Rhizopus arrhizus, and a mixed culture of activated sludge). Desorption and thermodynamics of the adsorption process were also investigated. With the exception of malathion, the adsorptive uptake data fit the Freundlich equation and were well correlated with the octanol/water partition coefficient, but not as well correlated with water solubility of the compounds. Except for malathion, the adsorption was reversible. Malathion showed unusually high apparent uptake and the removal appeared to be irreversible. The experimental evidence suggests that the disappearance of malathion resulted from a chemical reaction, while physical adsorption appears to account for removal of the other compounds. (Author's abstract)
W88-01935

BIOLOGICAL DECOMPOSITION OF TRACE ORGANIC COMPOUNDS,

Kurita Water Industries Ltd., Yokohama (Japan). Kurita Cental Labs.
M. Shibata, K. Nakamura, and Y. Miyaji.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 417-427, 1987. 6 fig, 6 tab, 6 ref.

Descriptors: *Biological wastewater treatment, *Wastewater treatment, *Organic compounds, *Fluidized bed process, *Semiconductor industry wastes, Trace levels, Biodegradation, Industrial wastes, Hydraulic properties, Effluents.

Biological decomposition of trace organic compounds was investigated to apply to the reclamation system of the rinse water recovered from semiconductor manufacturing processes. First, growth characteristics of microorganisms grown at low concentrations of organics were examined and extremely low saturation constants for acetate and methanol were obtained. Based on the growth characteristics, a biological fluidized bed reactor was operated to remove low concentrations of organics on a laboratory scale. One milligram per liter of acetate carbon was degraded to less than 10 micrograms/liter carbon with 10 minutes of hydraulic retention time. Low concentrations of methanol and isopropanol, which are the main organics contained in the recovered rinse water, were also decomposed effectively. For a full scale operation, a pilot study was also carried out to examine treatability and stability of a fluidized bed reactor. Effluent organic concentrations decreased gradually and were stable below 5 micrograms/liter carbon during 5 months of operation. (Author's abstract)
W88-01936

CHLORINATED HYDROCARBONS IN BIOLOGICAL SEWAGE PURIFICATION - FATE AND DIFFICULTIES IN BALANCING,

Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
H. F. Schroder.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 429-438, 1987. 3 fig, 6 tab, 15 ref.

Descriptors: *Fate of pollutants, *Chlorinated hydrocarbons, *Biological wastewater treatment, *Wastewater treatment, Path of pollutants, Hydrocarbons, Organic compounds, Lipophilic properties, Aeration, Sludge loading, Sample preservation, Chemical wastewater treatment.

The fate of some chosen chlorinated hydrocarbons in the biological sewage purification was determined. Fixed quantities (250 micrograms/liter wastewater) of the different volatile compounds such as chloroform, trichloroethylene, chlorobenzene, hexachloro-1,3-butadiene, 1,2-dichlorobenzene, 1,2,3-trichlorobenzene, hexachlorobenzene, 2,4-dichlorophenol, and gamma-hexachlorocylcohexane were dosed into the aeration tanks of the pilot plants. Chlorinated hydrocarbons in the inflow, waste air, effluent and excess sludge were extracted and tested for by GC/ECD. The results of these experiments were adapted with the results of recovery experiments. The balances of the low volatile and volatile compounds also was adapted by means of correction factors because of condensation effects. The very hydrophilic and low volatile chloroform was found up to 16% in the waste air, 63% in the effluent and 21% adsorbed on sludge. The very lipophilic and non-volatile hexachlorobenzene was found up to 16% in the effluent and 74% adsorbed on sludge. No hexachlorobenzene was found in the waste air. Biochemical degradation was observed for some of the compounds. The behavior of the chlorinated hydrocarbons in biological sewage purification depended on their volatility and lipophilic property, and also on the intensity of aeration and sludge loading. Balancing of volatile chlorinated hydrocarbons should be done by spot sampling. Bottles for composite samples should be stored in the refrigerator during the sampling period and should be sealed. (Author's abstract)
W88-01937

PREDICTION OF SOLUBLE NICKEL REMOVAL BY ACTIVATED SLUDGE USING FREE METAL ION CONCENTRATIONS,

New South Wales Inst. of Tech., Broadway (Australia). School of Civil Engineering.
J. S. Nielsen, S. E. Hrudey, and F. F. Cantwell.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 439-448, 1987. 2 fig, 1 tab, 30 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Nickel removal, *Nickel, Metal ions, Metals, Activated sludge, Isotherms, Mathematical equations, Metal complexes.

Batch isotherm studies using spiked sewage samples containing a range of total soluble nickel concentrations typical of municipal sewage strongly suggested that it is the free (i.e. uncomplexed) nickel ion that is sorbed by activated sludge. Equations relating nickel uptake by activated sludge to free nickel ion concentrations and the extent of complexation in untreated sewage were developed and applied. Predicted and measured nickel removals generally agreed to within plus or minus 30%. (Author's abstract)
W88-01938

BEHAVIOUR OF ALKYLPHENOL POLYETHOXYLATE SURFACTANTS AND OF NITRILOTRIACETATE IN SEWAGE TREATMENT,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5A.
W88-01939

RESPONSE OF PHTHALATE ESTERS-ACCLIMATED ACTIVATED SLUDGE TO 2,4-DINITROPHENOL,
Texas A and I Univ., Kingsville. Dept. of Civil and Mechanical Engineering.
R. Y. Tokuz.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 461-470, 1987. 4 fig, 6 tab, 9 ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Phthalate esters, *Ester acclimatization, Esters, 2,4-dinitrophenol, Chemical oxygen demand, Effluents, Industrial wastewater, Suspended solids, Activated sludge, Performance evaluation.

The process performance of an activated sludge system during acclimation to phthalate esters was examined. Concentration of the phthalate esters was increased gradually, and over about a two-week period, the acclimation to a mixture of 410 milligrams/liter (mg/L) diethyl phthalate and 540 mg/L dimethyl phthalate was complete. It was observed that the effluent chemical oxygen demand (COD) was not adversely affected in spite of increasing influent COD. Other indicators of process performance, for example, effluent suspended solids, were at acceptable levels at the completion of acclimation. The system responded well when 2,4-dinitrophenol, up to 4 mg/L, was included in the influent in addition to phthalate esters. Actually an improvement in system effluent COD was observed possibly due to increased mixed liquor suspended solids (MLSS). At a 2,4-dinitrophenol concentration of 8 mg/L, system performance deteriorated considerably but the recovery was fast, and within a two-week period, system performance returned to normal. (Author's abstract)
W88-01940

FATE OF TOXIC ORGANIC COMPOUNDS IN ACTIVATED SLUDGE AND INTEGRATED PAC SYSTEMS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
W. J. Weber, B. E. Jones, and L. E. Katz.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 471-482, 1987. 6 fig, 9 tab, 7 ref.
USEPA Research Contract CR 806030.

Descriptors: *Activated sludge process, *Powdered activated carbon, *Organic compounds, *Wastewater treatment, *Fate of pollutants, Hazardous materials, Activated carbon, Effluents, Biological wastewater treatment, Biodegradation, Volatilization, Adsorption.

The addition of powdered activated carbon (PAC) to activated sludge treatment systems to enhance removal of specific toxic organic compounds from wastewater was evaluated. Nine organic compounds encompassing a range of solubility, volatility, biodegradability, and adsorptive properties were studied. Rate and equilibrium investigations were conducted to quantify the removal mechanisms of volatilization, biodegradation, biosorption, and carbon adsorption. Results from steady-state bioreactor studies showed that the addition of less than 100 milligrams/liter (mg/L) powdered activated carbon to the influent did not enhance the removal of the biodegradable target compounds investigated: benzene, toluene, ethylbenzene, ortho-xylene, chlorobenzene, and nitrobenzene. Significantly improved removals of the poorly degradable and non-biodegradable compounds 1,2-dichlorobenzene, 1,2,4-trichlorobenzene, and lindane occurred at influent powdered carbon concentrations in the 12.5 to 25 mg/L range. Influent powdered carbon concentrations of 100 mg/L effected overall removals of greater then 90%. The addition of powdered activated carbon not only reduced effluent concentrations but also reduced the amounts of the volatile compounds stripped to the atmosphere. (Author's abstract)
W88-01941

PERFORMANCE EVALUATION OF ROTATING BIOLOGICAL CONTACTOR PROCESS,
Japan Sewage Works Agency, Toda. Research and Technology Development Div.
K. Tanaka, A. Oshima, and B. E. Rittmann.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 483-494, 1987. 12 fig, 5 tab, 8 ref, append.

Descriptors: *Rotating biological contactors, *Wastewater treatment, *Biological wastewater treatment, *Contact beds, Performance evaluation, Municipal wastewater, Evaluation, Japan, Model studies, Field tests, Biological oxygen demand, Effluents, Wastewater, Suspended solids, Separation techniques, Feasibility studies, Settling velocity.

Rotating Biological Contactors (RBC) were only recently introduced in Japan as a means of providing secondary treatment to domestic wastewaters. The use of RBCs appears to be particularly attractive for small communities because of their low energy demand and reduced O-M requirements. To evaluate and demonstrate the feasibility of the process as an alternative to conventional secondary treatment, a field study was performed at three municipal facilities in Japan. A single, fundamental model of biofilm kinetics was shown to be capable of accurately predicting soluble BOD5 removals throughout the RBC. Model and field study results indicated that effluent soluble BOD5 should be 3 to 7 mg/l for conventional loads. Approximately 30 percent of the RBC effluent solids were fine particles having a settling velocity of less than 10 to 15 m/day and which exerted 60 to 70% of the final effluent total BOD5. Therefore, special attention must be given to solids-liquid separation of the RBC effluent to ensure that the final effluent is of acceptable quality. Several solids-liquid separation methods, including direct screening of RBC effluent, were shown to be feasible in upgrading the effluent quality. (Author's abstract)
W88-01942

SIGNIFICANCE OF SEGREGATION OF BIOMASS IN BIOFILMS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5B.
W88-01943

APPLICATION OF BATCH KINETIC DATA TO THE SIZING OF CONTINUOUS-FLOW ACTIVATED SLUDGE REACTORS,
California Univ., Berkeley. Dept. of Sanitary and Environmental Engineering.
A. van Niekerk, D. Jenkins, and M. G. Richard.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 505-516, 1987. 9 fig, 10 ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Sludge reactor sizing, *Kinetics, Sludge, Activated sludge, Wastewater, Data interpretation, Continuous flow reactors, Mathematical equations, Rate equations, Organic carbon, Chemical oxygen demand, Biological oxygen demand.

The removal of substrates from wastewaters by activated sludge is commonly expressed in terms of a collective substrate parameter such as COD, BOD5 or TOC. Several different linear and non-linear rate expressions are employed to describe complex substrate removal in the literature. The indiscriminate application of batch substrate uptake rates to the analysis or design of continuous-flow reactors can introduce errors. These potential errors have particular significance in the design of aerobic selectors used to control low F/M bulking. (Author's abstract)
W88-01944

CRITICAL EVALUATION OF MICROBIAL PRODUCT FORMATION IN BIOLOGICAL PROCESSES,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. E. Rittmann, W. Bae, E. Namkung, and C. J. Lu.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 517-528, 1987. 5 fig, 1 tab, 36 ref.
EPA Cooperative Agreement CR 810462.

Descriptors: *Biological wastewater treatment, *Microbial products, *Wastewater treatment, *Kinetics, *Mathematical models, Model studies, Microbial product characteristics, Microbiological studies, Mathematical equations, Substrates, Biomass.

A critical evaluation of the characteristics of soluble microbial products (SMP) indicates SMP is comprised of many different types and sizes of molecules and is biodegradable. A portion of SMP is formed at a rate proportional to the rate of substrate utilization while the rest is formed at a rate proportional to the concentration of active biomass. These characteristics are incorporated into a mathematical model that includes the following components: substrate utilization and biomass growth according to Monod kinetics, SMP formation kinetics in proportion to substrate utilization rate and biomass accumulation, and SMP degradation according to a semi-empirical multicomponent degradation model. The SMP formation/degradation model successfully describes the fractional conversion of substrate into SMP, including the observed trends of increasing conversion at high and low sludge ages. In addition to activated sludge, the model is applied to anaerobic treatment and to biofilm processes. (Author's abstract)
W88-01945

MOLECULAR WEIGHT DISTRIBUTIONS OF SOLUBLE ORGANIC MATTER IN VARIOUS SECONDARY AND TERTIARY EFFLUENTS,
Arizona Univ., Tucson. Dept. of Civil Engineering.
G. L. Amy, C. W. Bryant, and M. Belyani.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 529-538, 1987. 5 tab, 16 ref.

Descriptors: *Organic matter, *Effluents, *Wastewater treatment, *Molecular weights, *Statistical analysis, Secondary wastewater treatment, Tertiary wastewater treatment, Activated sludge process, Biological wastewater treatment, Filtration, Seasonal variation, Arizona, Distribution patterns.

Differences in the nature of soluble organic matter were measured for various full-scale wastewater treatment processes. Conventional activated sludge, pure oxygen activated sludge, biofiltration, granular activated carbon, and tertiary sand filtration were evaluated using effluent obtained from facilities in Metropolitan Tucson, Arizona. Effluent soluble organic matter was analyzed by ultrafiltration for the apparent molecular weight distribution of soluble organic carbon and UV-absorbing material. The effects of annual season, secondary treatment process, and tertiary treatment process upon the properties of the effluent soluble organic matter were statistically significant at the 99% level. Effluent properties from the various treatments were sufficiently different to support the concept of the selection of appropriate treatments to minimize the effluent concentration of specific fractions of the soluble organic material as required

for specific water reuse applications. (Author's abstract)
W88-01946

SURVIVAL OF INDICATOR ORGANISMS IN A DETENTION POND RECEIVING COMBINED SEWER OVERFLOW,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
For primary bibliographic entry see Field 5B.
W88-01948

DISINFECTION EFFICIENCY AND PROBLEMS ASSOCIATED WITH MATURATION PONDS,
State Pollution Control Commission, Lidcombe (Australia).
R. J. Macdonald, and A. Ernst.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 557-567, 1987. 3 fig, 3 tab, 11 ref.

Descriptors: *Maturation ponds, *Monitoring, *Wastewater treatment, *Microbiological studies, Effluents, Quality control, Disinfection, Pollutants, Wastewater, Pathogens, Filtration, Activated sludge process, Detention time, Design criteria, Tracers.

Reductions in densities of indicator organisms and pathogens were measured in maturation ponds receiving secondary effluents from trickling filter and activated sludge treatment works. Effluent detention times in the ponds were determined using dye tracing techniques and compared with nominal detention times calculated from pond volumes and effluent flow rates. Median detention times were substantially less than nominal times because of short circuiting due to pond design aspects and thermal stratification. Maturation ponds of 10 days median detention time were found to successfully disinfect a poor quality trickling filter effluent and were effective at removing parasite ova and reducing virus intensities. Continued use of maturation ponds should be encouraged in developed and developing countries as they have low cost, operational, maintenance and skilled operator requirements and are an effective disinfection process. Pond designs should minimize short circuiting and thus the areal requirements of the ponds. (Author's abstract)
W88-01949

REMOVAL OF EXCRETED BACTERIA AND VIRUSES IN DEEP WASTE STABILIZATION PONDS IN NORTHEAST BRAZIL,
Leeds Univ. (England). Dept. of Civil Engineering.
J. I. Oragui, T. P. Curtis, S. A. Silva, and D. D. Mara.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 569-573, 1987. 1 fig, 2 tab, 16 ref. Science and Engineering Research Council of the United Kingdom Grant GR/C/30191.

Descriptors: *Microbiological studies, *Stabilization ponds, *Wastewater treatment, *Bacteria, *Viruses, Bacteria removal, Virus removal, Coliforms, Streptococcus, Salmonella, Enteroviruses, Brazil, Ponds, Wastewater, Retention time, Pathogen removal, Pathogens, Stabilization ponds.

The removal of excreted bacteria (fecal coliforms, fecal streptococci, Clostridium perfringens, total and sorbitol-fermenting bifidobacteria, salmonellae and thermophilic campylobacters) and viruses (enterovirus and rotavirus) in a series of deep anaerobic facultative and maturation ponds (depth range: 2.8 - 3.4 m), with an overall retention time of 21 days and a mean mid-depth temperature of 27 degrees C, was studied. Thermophilic campylobacters, bifidobacteria and salmonellae were not detected after 11, 16, and 21 days' retention respectively. Fecal coliforms, fecal streptococci and C. perfringens were reduced by 4, 4, and 2 orders of magnitude respectively, and enteroviruses and rotaviruses both by 3 orders. The results indicate that pathogen removal in deep ponds is similar to that in ponds of normal depth. (Author's abstract)
W88-01950

DIMENSIONING OF COMBINED SEWER SYSTEM DETENTION BASINS BY LONG TERM SIMULATION OF STORM WATER RUNOFF,
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft, Hydrologie und Landwirtschaftlichen Wasserbau.
F. Sieker, and A. Durchschlag.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 581-588, 1987. 5 fig, 1 tab, 4 ref.

Descriptors: *Detention basins, *Design criteria, *Wastewater treatment, *Combined sewers, *Urban runoff, *Rainfall-runoff relationships, *Simulation analysis, *Model studies, Sewers, Germany, Hydrologic models, Hydrographs, Flow discharge, Runoff, Storm runoff, Mathematical equations, Sanitary wastewater.

At present, dimensioning of combined sewer detention basins in Germany is based on the rational formula and on the idea of the existence of the so-called 'first flush.' New measurements and recent investigations led to the questioning of this dimensioning procedure. An alternative is developed based on the application of a stormwater-runoff model (hydrological and/or hydrodynamic) in each special case. Input to the model is a period of at least one decade of continuous rainfall data (long term simulation). The sanitary wastewater component is superimposed on the simulated runoff-hydrograph. The first flush-effect is neglected. The dimensioning of a detention basin is based on the determination of several quantities such as number, duration, peak discharge and volume of overflow events in relation to the total water detention volume of the system. The decision on final dimensioning must be made with respect to the characteristics of the receiving water. (Author's abstract)
W88-01952

INFILTRATION RATES FOR SEPARATE SEWAGE COLLECTION SYSTEMS,
Gutteridge, Haskins and Davey, Melbourne (Australia).
J. B. Murray.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 589-601, 1987. 2 fig, 5 tab, 6 ref.

Descriptors: *Sewer systems, *Hydraulics design, *Infiltration rate, *Wastewater treatment, *Sewer hydraulics, *Sewer infiltration, *Separated sewers, Wastewater, Infiltration, Sewers, Hydraulic permeability, Design criteria, Australia, Melbourne, Capital costs, Economic aspects, Costs, Hydraulic design.

A review of the current sewage practices in the suburbs of Melbourne, Australia which are characterized by surface grades of less than 0.5%, sand generally to depth, permanent water table at depths of 1-1.5 m, and a density of development for the majority that exceeds 85% of the design density of about eight tenements/ha, is presented. A practical design, associated construction criteria, and layout were proposed which would minimize capital cost and annual expenditure. Because infiltration rates play a large part in the determination of required hydraulic capacity and physical size of the collection system, treatment plant, and disposal works, an assessment of the factors that affect infiltration rates is detailed; sections on catchment characteristics and construction materials are included. Infiltration rates are forecasted based on measured rates, and include an arbitrary 50% increase to allow for the potential loss of water-tightness during the design life of the collection system. Routine internal inspections over more than 12 years of the collection by the sewer systems showed no structural failure or loss of water-tightness, so the loss of water-tightness is likely to be substantially less than the assumed 50%. The forecasted rates confirm the effectiveness of the adopted design and construction criteria to minimize infiltration and justify the adopted design rates. (Wood-PTT)
W88-01953

MAINTENANCE STRATEGIES FOR SEWERAGE SYSTEMS,
Universidade Nova de Lisboa (Portugal). Environmental Systems Analysis Group.
A. S. Camara, D. Pereira, A. Fonseca, and S. Sequeira.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 603-611, 1987. 2 fig, 6 tab, 12 ref.

Descriptors: *Sewer systems, *Sewer maintenance, *Wastewater facilities, *Maintenance, Sewers, Algorithms, Costs, Maintenance costs, Decision making, Portugal, Cleaning, Inspection, Scheduling.

The problem of decaying sewerage systems is a timely topic in many urban areas, due to its importance to societal needs and to the large amounts of capital expenditures needed to bring the concerned systems to an adequate level of serviceability. Thus, there is a need for better maintenance decision-making related to periodic inspection and cleaning and repair rehabilitation or replacement of the equipment. An approach offering integrated solutions to upgrade such systems, taking into account existing and foreseen structural and hydraulic conditions, is presented. The methodology relies upon a heuristic algorithm scheduling maintenance events. An application to the Almada sewerage network in Portugal illustrates the method. Future improvements including the use of statistical maintenance theoretic concepts and artificial intelligence approaches are also discussed. (Author's abstract)
W88-01954

ACTIVATED SLUDGE SETTLERS: DESIGN AND OPTIMIZATION,
Universidade Federal da Paraiba, Campina Grande (Brazil). Dept. of Civil Engineering.
P. F. C. Catunda, and A. C. van Haandel.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 613-623, 1987. 7 fig, 6 ref.

Descriptors: *Sludge settling, *Activated sludge, *Optimization, *Wastewater treatment, *Sludge thickening, *Clarification, *Design criteria, Sludge, Sludge conditioning, Sedimentation, Settling characteristics, Settleable solids, Load distribution, Solids, Mathematical equations, Mathematical studies, Settling velocity, Suspended solids, Economic aspects.

Activated sludge settlers perform two functions simultaneously: clarification and sludge thickening. Depending on the values of the mixed liquor and return sludge concentrations and on the sludge settling characteristics, either one of these functions may limit the solids loading rate that can be applied to the settler. This rate in turn determines the required settler surface area. A method is developed to establish which of the two functions is determinant for the maximum solids loading rate in a particular design situation. Expressions are derived to calculate the required settler surface area for clarification and for thickening. These expressions are based on the experimentally verified supposition that the zone settling velocity decreases exponentially with increasing suspended solids concentration. A graphical method to determine the optimal mixed liquor and return sludge concentrations for minimum construction and operational cost is presented. (Author's abstract)
W88-01955

LOW-COST WASTEWATER TREATMENT WITH THE USE OF AN INTRACHANNEL CLARIFIER IN OXIDATION DITCHES,
Armco Argentina S.A., Buenos Aires.
O. R. Velez, and J. Foil.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 625-632, 1987. 6 fig, 3 tab, 9 ref.

Descriptors: *Clarification, *Wastewater treatment, *Oxidation process, *Wastewater oxidation, *Intrachannel clarifiers, Oxidation, Wastewater oxidation, Economic aspects, Aeration, Design criteria, Argentina, Costs.

The oxidation ditches developed by Pasveer of Holland and Muskat in Germany have been used in small communities for many years as a cost-effec-

tive secondary treatment. Generally designed and operated as part of an extended aeration system, these plants provide from 18 to 30 hours of hydraulic detention time, followed by a 3 to 6 hour settling period in a secondary clarifier, with return of 100 percent of settled solids to the aeration tank. Because of these design criteria, the oxidation ditches were not widely used in large populations as the aeration system normally used required a relatively low water depth to be efficient - a fact that meant extensive land areas. Recent innovations in the clarification and aeration systems have rendered this treatment attractive again for communities of all sizes. The use of an upflow intrachannel clarifier, in particular, eliminates the need for a separate secondary clarifier, and return sludge pumping and piping. In addition, an innovative diffused aeration system permits the use of channels with a greater water depth, which not only optimizes the process as an oxidation ditch, but also makes it remarkably competitive with respect to conventional biological treatment systems. The conceptual design of the innovative oxidation ditch system, its economic aspects, and its first application in Argentina using low-cost construction technology were discussed. (Author's abstract)
W88-01956

OXIDATION-REDUCTION POTENTIAL (ORP) REGULATION: A WAY TO OPTIMIZE POLLUTION REMOVAL AND ENERGY SAVINGS IN THE LOW LOAD ACTIVATED SLUDGE PROCESS,
Compagnie Generale des Eaux, Paris (France).
J. Charpentier, M. Florentz, and G. David.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 645-655, 1987. 9 fig, 6 tab, 6 ref.

Descriptors: *Activated sludge processes, *Wastewater treatment, *Oxidation-reduction potential regulation, *Oxidation process, Aeration, Optimization, Energy, France, Wastewater, Pollution load, Energy consumption, Economic aspects, Pollutants, Comparison studies, Dissolved oxygen.

Aeration represents the main part of energy consumption in the low-load activated sludge process. Because of its ability to remove the various kinds of pollution (carbonaceous, nitrogenous) with a high dependability level, this process is the most widespread throughout France, particularly in its tropical overseas regions. A previous study resulted in a graph which links energy savings and effluent quality (carbonaceous and nitrogenous pollution removal). The graph also appears to be useful for monitoring biological phosphorus removal in the low-load activated sludge process including an aerobic basin. In order to optimize pollution removal and energy savings, oxidation-reduction potential (ORP) regulation was carried out starting in January 1983 on the Yffiniac plant in western France. ORP regulation was preferred to dissolved oxygen (DO) regulation because of the low DO values observed in this plant and the difficulties of DO regulation. Laboratory and full-scale studies show that ORP regulation is possible and particulary accurate as a contribution to optimizing pollution removal, energy savings and operating conditions. Cases which lend themselves to successful ORP regulation were specified. (Author's abstract)
W88-01958

COMPUTER AIDED CONTROL OF NITROGEN REMOVAL IN SMALL ACTIVATED SLUDGE WASTEWATER TREATMENT PLANTS,
Ruhr Univ., Bochum (Germany, F.R.). Lehrstuhl fuer Wasserwirtschaft und Umwelttechnik II.
G. Bahre.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 657-667, 1987. 8 fig, 1 tab, 10 ref.

Descriptors: *Nitrogen removal, *Activated sludge process, *Wastewater treatment, *Computer programs, *Process control, Computers, Aeration, Retention time, Nitrification, Denitrification, Energy costs, Economic aspects, Monitoring.

Extended aeration plants achieve almost complete nitrification, due to their mean solids retention time of more than two weeks. Intelligent control of nitrification and denitrification processes is called for in order to limit high energy costs for additional oxygenation, to prevent uncontrolled denitrification processes in the final settling tanks (which impair the effluent quality), and to prevent high effluent nitrogen concentrations. Long experience is available from the application of an on-line nitrate monitor; interpretation of this gives detailed information about nitrification and denitrification processes and kinetics under real operating conditions, depending on temperature, MLSS, BOD and total nitrogen mass flow rates. The poor availability and reliability of the nitrate monitor as a control element led to the development of computer-aided control of the nitrogen removal processes. A common computer system was completed with electronic filters, A/D converters and relay interfaces to control the functions of a new bubble diffusor system and three air blowers. The software is able to calculate the length of aerobic and anoxic intervals in order to realize a saw-tooth-like graph of NO sub x concentration under various conditions. It also surveys the DO level during aeration periods. (Author's abstract)
W88-01959

FIELD VERIFICATION OF ON-LINE INSTRUMENTATION AT A MUNICIPAL WASTEWATER TREATMENT PLANT,
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
G. W. Speirs, and R. D. Hill.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 669-680, 1987. 8 fig, 1 tab, 7 ref.

Descriptors: *Process control, *Activated sludge process, *Wastewater treatment, *Instrument verification, *Computers, Monitoring, Field tests, Municipal wastewater, On-line sensors, Aeration, Calibration, dissolved oxygen, Economic aspects.

As part of a full-scale project to demonstrate the advantages of using automated process control in wastewater treatment plants, on-line sensors used in various control loops were calibrated and/or verified during control system commissioning and startup. The on-line measurements included liquid flow rates, air flow rates, suspended solids concentrations, and dissolved oxygen concentrations. The methods used to confirm instrument performance are presented along with results that show that several instruments were found to operate outside the manufacturers' written specifications. In addition, on-line methods which can help determine when recalibrations are required, and thereby help to reduce maintenance costs and ensure reliability, are also presented. (Author's abstract)
W88-01960

RESPONSE OF FECAL COLIFORMS AND ANTIBIOTIC-RESISTANT ESCHERICHIA COLI TO INCREMENTAL DOSES OF OZONE DURING DISINFECTION OF ACTIVATED SLUDGE EFFLUENT,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
G. R. Finch, and D. W. Smith.
Environmental Technology Letters ETLEDB, Vol. 8, No. 1, p 1-8, January 1987. 4 fig, 4 tab, 39 ref. Alberta Environmental Research Trush Grant T0937 and NSERC (Canada) Grant A1010.

Descriptors: *Coliforms, *Ozonation, *Activated sludge, *Escherichia, *Wastewater treatment, Wastewater, Effluents, Antibiotics, Bacteria, Disinfection.

The responses of fecal coliforms and multiple-antibiotic-resistant (MAR) Escherichia coli to incremental doses of ozone were examined in three batches of activated sludge effluent from the same plant. The dose-response function of fecal coliforms resembled the 'breakpoint' response typical of ozone disinfection of polluted waters. A logit model adequately described the dose-response function after the breakpoint. The MAR E. coli displayed random variation throughout the entire range of applied ozone doses. It was concluded that the ozone dose had no apparent effect on the antibiotic-resistance profile of wastewater. (Author's abstract)
W88-02006

ANALYSIS OF ANAEROBIC BIOFILMS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
M. S. Switzenbaum, and R. B. Eimstad.
Environmental Technology Letters ETLEDB, Vol. 8, No. 1, p 21-32, January 1987. 1 fig, 6 tab, 22 ref. DOE Contract 31-109-38-6995.

Descriptors: *Biofilms, *Anaerobic sludge, *Wastewater treatment, Wastewater, Effluents, Enzymes, Inorganic matter, Oxygen, Microbiology.

Biofilms from anaerobic fixed film reactors (anaerobic filter, upflow anaerobic sludge blanket, and anaerobic fluidized bed) developed under identical experimental conditions, were characterized in terms of chemical, microbiological, and morphological composition. Using Scanning Electron Microscopy (SEM), the nature of the biofilms are described. Factor 420 analysis showed the fluidized bed to have the highest level of the coenzyme. However, factor 420 levels were not related to COD removal or gas production. Large amounts of inorganic matter were found in each of the biofilms. (Author's abstract)
W88-02008

APPLICATION OF ANAEROBIC FLUIDIZED BED FOR TREATMENT OF HIGHLY POLLUTED EFFLUENTS (APPLICATION DE LIT FLUIDISE ANAEROBIE AU TRAITEMENT DES EFFLUENTS A FORTE CHARGE ORGANIQUE),
Mahidol Univ., Bangkok (Thailand). Faculty of Public Health.
Y. Witaya, and B. Alain.
Environmental Technology Letters ETLEDB, Vol. 8, No. 1, p 33-42, January 1987. 7 fig, 6 tab, 20 ref.

Descriptors: *Fluidized beds, *Anaerobic digestion, *Industrial wastewater, *Wastewater treatment, Wastewater, Effluents, Bacteria, Biogas, Oxygen demand.

An anaerobic fluidized bed reactor was evaluated for the treatment of effluent of a tapioca plant. The volume of the reactor was about 40 liters; activated carbon was used as support of bacteria. The influent had 6.4 kg/cu m COD and contained 4.4 kg/cu m suspended solids (SS). The hydraulic retention time varied from 5 to 29 hours. The values of efficiency varied from 57.9 to 88.3% COD for an average yield of biogaz of 2.2 to 6.5, i.e. in the range of 0.355 to 0.54/cu m biogas/ kg COD. (Author's abstract)
W88-02009

BIOLOGICAL TREATMENT OF MINING EFFLUENTS,
National Inst. for Water Research, Pretoria (South Africa).
J. P. Maree, A. Gerber, A. R. McLaren, and E. Hill.
Environmental Technology Letters ETLEDB, Vol. 8, No. 2, p 53-64, February 1987. 4 fig, 3 tab, 11 ref.

Descriptors: *Biological wastewater treatment, *Mine wastes, *Heavy metals, *Wastewater treatment, Wastewater, Effluents, Chemical precipitation, Sulfides, Sulfates.

A multi-stage biological process is described for treating effluents containing high levels of calcium sulfate, soluble organic matter and heavy metals. Sulfate is reduced anaerobically to sulfide which is used to precipitate heavy metals, while the remaining H2S is stripped off. Residual soluble organic matter from the first stage is removed aerobically in a second stage. Effluent saturated with respect to calcium sulfate required 3 g molasses/L effluent to convert 90% of the influent sulfate to sulfide. (Author's abstract)
W88-02010

ANAEROBIC BIODEGRADATION OF MONOCHLOROPHENOLS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
S. E. Hrudey, E. Knettig, S. A. Daignault, and P. M. Fedorak.
Environmental Technology Letters ETLEDB, Vol. 8, No. 2, p 65-76, February 1987. 5 fig, 2 tab, 14 ref.

Descriptors: *Monochlorophenols, *Chlorophenols, *Chlorinated hydrocarbons, *Phenols, *Anaerobic digestion, *Biological wastewater treatment, *Wastewater treatment, Wastewater, Effluents, Biodegradation, Organic compounds, Bacteria, Cultures.

Anaerobic degradation of 2-, 3-, and 4-chlorophenol, with and without phenol supplementation, was investigated. 2-Chlorophenol was readily degraded and mineralized at concentrations as high as 285 mg/L. However, 3- and 4-chlorophenol were only degraded after very long acclimation times. Concentrations >30 mg/L of 3- or 4-chlorophenol inhibited ultimate phenol degradation whereas concentrations of 2-chlorophenol < or = 97 mg/L were not inhibitory to ultimate phenol degradation. Semi-continuous cultures demonstrated degradation of 2-chlorophenol at 100 mg/L with methane production. (Author's abstract)
W88-02011

EFFECTS OF PERIODIC FEAST/FAMINE CONDITIONS ON THE GROWTH OF BIOFILMS,
Technische Univ. Hamburg-Harburg (Germany, F.R.).
M. Rubio, and P. A. Wilderer.
Environmental Technology Letters ETLEDB, Vol. 8, No. 2, p 87-94, February 1987. 4 fig, 8 ref. German Minister of Research and Technology Grant 1440 386 B/7.

Descriptors: *Biofilms, *Biological wastewater treatment, *Wastewater treatment, Wastewater, Effluents, Substrates, Microbiology.

Two rotating biological contractors (RBC) were operated according to a sequencing batch reactor (SBR) strategy. The reactor basins were periodically filled and drained. A thin biofilm developed in the reactor in which the substrate concentration was maintained at a relatively low level (slow fill strategy). In contrast, a very voluminous biofilm developed, and sloughing occurred in the reactor in which the substrate concentration was allowed to increase rapidly (fast fill strategy). It is concluded that periodic changes of the substrate concentration are to be minimized in order to enable exploitation of the capacity of biofilm reactors. (Author's abstract)
W88-02012

KINETICS OF AN ACTIVATED BIOFILTER PROCESS,
Regina Univ. (Saskatchewan). Faculty of Engineering.
T. Viraraghavan, and G. N. Mathavan.
Environmental Technology Letters ETLEDB, Vol. 8, No. 3, p 105-112, March 1987. 1 fig, 14 ref.

Descriptors: *Activated biofilter process, *Model studies, *Biokinetics, *Wastewater treatment, Wastewater, Effluents, Prediction, Biomass.

The activated biofilter (ABF) unifies the two basic concepts of biological wastewater treatment systems viz. fixed film and suspended growth systems. A mathematical model for the biokinetics involved in the ABF process is derived. The model predicts the biomass concentration in the biocell thereby facilitating unit performance evaluation and system biokinetic parameter determination. (Author's abstract)
W88-02017

OIL/WATER SEPARATION WITH SURFACE MODIFIED MEMBRANES,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
G. K. Anderson, and C. B. Saw.
Environmental Technology Letters ETLEDB, Vol. 8, No. 3, p 121-132, March 1987. 9 fig, 1 tab, 15 ref.

Descriptors: *Membrane processes, *Oil, *Filtration, *Adsorption, *Wastewater treatment, Wastewater, Effluents, Separation, Design criteria.

The feasibility of designing a membrane surface which would enhance the separation of oil from oil/water suspensions using crossflow filtration is examined. The surface characteristics of both ultrafiltration and microfiltration membranes were modified by adsorption with a surfactant, resulting in significant improvement in oil rejection. (Author's abstract)
W88-02018

ISOLATION OF FUNGI FROM ENVIRONMENTAL SAMPLES,
For primary bibliographic entry see Field 5A.
W88-02019

STABLE FOAMS IN ACTIVATED SLUDGE PLANTS,
Birmingham Univ. (England). Dept. of Civil Engineering.
A. J. Goddard, and C. F. Forster.
Enzyme Microl Technol EMTED2, Vol. 9, No. 3, p 164-168, March 1987. 4 fig, 3 tab, 29 ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Microbiological studies, *Foam index, *Foaming, Suspended solids, Bacteria, Reactors.

A study of several full-scale activated sludge plants has confirmed that while stable foam formation is associated with a dominance of the sludge flora by Nocardia or Microthrix parvicella, the degree of dominance is not related to the foaming potential as measured by a novel 'foam index.' The data also show the significance that the suspended solids concentration has on foaming. (Author's abstract)
W88-02055

CULTURE OF ENDOMYCES FIBULIGER IN MUSSEL PROCESSING WASTES AND PRECIPITATION WITH PEGS OF ITS EXTRACELLULAR AMYLOLYTIC SYSTEM,
Instituto de Investigaciones Pesqueras de Vigo (Spain).
For primary bibliographic entry see Field 5C.
W88-02060

APPLYING LESSONS FROM HOUSING TO MEETING THE CHALLENGE OF WATER AND SANITATION FOR THE URBAN POOR,
California Univ., Berkeley. Inst. of Urban and Regional Development.
For primary bibliographic entry see Field 5F.
W88-02062

TROPHIC RELATIONS BETWEEN TWO AGENTS OF SEWAGE PURIFICATION SYSTEMS: ALGAE AND MOSQUITO LARVAE,
Kinneret Limnological Lab., Tiberias (Israel).
M. Gophen, and M. Gophen.
Agricultural Wastes AGWADL, Vol. 15, No. 3, p 159-168, 1986. 1 fig, 5 tab, 17 ref.

Descriptors: *Selenastrum, *Grazing, *Mosquitoes, *Larval growth stage, *Biological wastewater treatment, *Wastewater treatment, Growth stages, Algae, Density, Population density, Growth, Excretion, Plankton, Organic matter, Productivity, Aquatic productivity.

A study of the grazing of the algae Selenastrum sp. by mosquito larvae (Culex pipiens), which are common agents in sewage purification systems, was carried out. The effect of larval excretions on the algal growth was determined along with the effects of temperatures (15-28 C), light-dark conditions, larval densities, and size and initial algal concentrations on the grazing activity. Small larvae were more active than large, and light simulated higher activity than dark conditions. Increasing larval densities and initial algal concentrations enhanced grazing activity. Larval excretions of P and NH3-N enhanced algal growth slightly. The advantages and disadvantages of the presence of mosquito larvae in sewage purification systems is discussed. (Author's abstract)
W88-02065

AERATION AND CONTROL OF SLURRY ODOURS BY HETEROTROPHS,
West of Scotland Agricultural Coll., Auchincruive.
M. R. Evans, E. A. Deans, M. P. W. Smith, I. F. Svoboda, and F. E. Thacker.
Agricultural Wastes AGWADL, Vol. 15, No. 3, p 187-204, 1986. 7 fig, 3 tab, 18 ref.

Descriptors: *Farm wastes, *Manure, *Slurries, *Odors, *Aeration, *Heterotrophic bacteria, *Biodegradation, *Biological wastewater treatment, *Wastewater treatment, Organoleptic properties, Bacteria, Anaerobic bacteria, Oxygen, Dissolved oxygen, Oxidation, Biological oxygen demand, Biological oxidation, Wastewater oxidation, Organic compounds, Aerobic bacteria.

In continuous-culture aeration, heterotrophic activity varied with mean treatment time and treatment temperature, but was unaffected by the level of dissolved oxygen provided it was maintained above 1% of saturation. At temperatures from 15 to 50 C, most of the slurry odorants were removed even after very short treatment times. Below 1% of dissolved oxygen saturation, heterotrophic activity, in particular the oxidation of odorants and BOD5 material, varied with the oxygen concentration as well as mean treatment time and temperature. At 35 and 50 C, total residual COD and BOD5 were both similarly related to changes in redox potential. At 15 C, only the total residual BOD5, not the total residual COD, was related to redox potential. This could indicate that at lower temperatures some fermentative activity occurs at low aeration rates. Treatment times must normally exceed seven days and redox potential during treatment must be high enough to avoid rapid regeneration of odorants after treatment. (Author's abstract)
W88-02067

NITROGEN AND AEROBIC TREATMENT OF SLURRY,
West of Scotland Agricultural Coll., Auchincruive.
M. R. Evans, M. P. W. Smith, E. A. Deans, I. F. Svoboda, and F. E. Thacker.
Agricultural Wastes AGWADL, Vol. 15, No. 3, p 205-213, 1986. 1 fig, 2 tab, 6 ref.

Descriptors: *Wastewater treatment, *Farm wastes, *Manures, *Slurries, *Nitrogen, *Biological wastewater treatment, *Hogs, *Cattle, *Aerobic digestion, Digestion, Biodegradation, Aeration, Oxidation, Biological oxidation, Wastewater oxidation, Ammonia, Chemical reactions, Odors, Organoleptic properties, Nitrification, Oxygen.

The effects on slurry nitrogen of the aerobic treatment of pig and cattle excreta under various aeration regimes are described. The three regimes tested had imported effects on the mineralized nitrogen components of the excreta. This nitrogen could be conserved as ammoniacal nitrogen, lost via ammonia stripping, oxidized to nitrate and conserved, or lost via denitrification. They also had important implications for energy conservation and odor regeneration. The energy requirement for aerobic treatment was minimal when the dissolved oxygen level was as low as possible and still consistent with adequate treatment. Conservation of the mineralized nitrogen as nitrate may prevent odor regeneration subsequent to treatment, but a dissolved oxygen level > 15% of saturation was required. In addition, the oxygen requirement for nitrification was equivalent to about 30-80% of the heterotrophic oxygen demand. Thus, with minimal aeration the efficiency was maximized, the extra oxygen demand for nitrification prevented, and the nitrogen conserved as ammonia, but odor regen-

eration could be fairly rapid during storage. (Author's abstract)
W88-02068

ONE SOLUTION TO THE PROBLEM OF HANDLING AND TREATING SLURRY FROM A PIG FATTENING HOUSE,
National Inst. of Agricultural Engineering, Silsoe (England). Farm Buildings Div.
R. W. Sneath.
Agricultural Wastes AGWADL, Vol. 15, No. 4, p 289-308, 1986. 3 fig, 7 tab, 11 ref, 2 append.

Descriptors: *Slurries, *Hogs, *Land disposal, *Manure, *Separation techniques, *Wastewater treatment, *Biological filters, *Flocculation, *Waste disposal, Farm wastes, Evaporation, Filters, Livestock, Pumps.

A competitive solution is described for handling the slurry of some intensive pig houses. The system is based on mechanical and chemical separation techniques. The solids produced are easy to store until they can be spread on neighboring land, and their smell is inoffensive. The liquids produced are greatly reduced in bulk, by evaporation, and in polluting potential, thereby reducing the problems of their eventual disposal. At a treatment plant in a piggery, slurry was flushed from the channels hourly and passed through a mechanical separator, enabling a high rate biological filter to treat the separated liquid reliably. The treated separated liquid was then flocculated, leaving up to 40% of the input slurry as a semi-solid at 15% dry matter together with a clear filtrate liquid, much of which was evaporated by diverting air from the ventilation system through an air scrubber/evaporator. Thus, only 30% of the original slurry had to be discharged as liquid. With design modifications to the treatment plant and close control of water wastage, this figure of 30% can be reduced to zero, i.e., an output of solids only. (Author's abstract)
W88-02070

REVIEW OF FULL-SCALE ANAEROBIC DIGESTION IN CHINA,
Polytechnic of Wales, Pontypridd. Dept. of Mechanical and Production Engineering.
D. L. Hawkes.
Agricultural Wastes AGWADL, Vol. 18, No. 3, p 197-205, 1986. 3 fig, 15 ref.

Descriptors: *Reviews, *Anaerobic digestion, *China, *Symposium, *Biological wastewater treatment, *Wastewater treatment, Conferences, Education, Agriculture, Biodegradation, Digestion, Waste disposal, Wastewater treatment, Wastes, Animal wastes, Domestic wastes, Farm wastes, Industrial wastes.

A review of full-scale working digesters in China is presented based on information gained from the Fourth International Symposium on Anaerobic Digestion held at Guangzhou, Guandong Province. Of 450 delegates present at the conference, more than 180 were from outside China. Although there have been digesters working in China since the 1920s, they were constructed at very low cost, and many leaked. The major developments have taken place since the early 1970s, when government policy encouraged the development of more and better systems. This policy has now resulted in a total of 4.48 million domestic biogas digesters working well and mainly situated in rural areas. Topics discussed include the historical background, government training policy, rural digesters, digester construction, use of gas and digester residues, and industrial digesters. A technical visit by symposium participants to a farm using five digesters with a total capacity of 1,059 cu m is described; the gas production is used as fuel, while digester effluent is used as fertilizer and in fish ponds. (Author's abstract)
W88-02073

IRRIGATION OF PRIMARY TREATED AND ANAEROBICALLY TREATED MEAT-PROCESSING WASTES ONTO PASTURE: LYSIMETER TRIALS,
Meat Industry Research Inst. of New Zealand, Hamilton.
For primary bibliographic entry see Field 5E.
W88-02074

VIROLOGICAL STUDIES ON AN ANAEROBIC DIGESTION SYSTEM FOR LIQUID PIG MANURE,
Guelph Univ. (Ontario). Dept. of Veterinary Microbiology and Immunology.
J. B. Derbyshire, H. D. Monteith, and E. E. Shannon.
Agricultural Wastes AGWADL, Vol. 18, No. 4, p 309-312, 1986. 1 tab, 7 ref.

Descriptors: *Viruses, *Wastewater treatment, *Microbiological studies, *Anaerobic digestion, *Biological wastewater treatment, *Hogs, *Manure, *Enteroviruses, Biodegradation, Digestion, Effluents, Centrifugation, Kidneys, Tissue analysis, Culturing techniques.

Virological observations were made under field conditions on a large-scale anaerobic digestion system for the treatment of liquid pig manure. Samples of raw liquid pig manure, anaerobic digester effluent, screened digester solids, screened digester effluent, anaerobic digestion residue derived by centrifugation of the screened digester effluent, the centrifuge centrate, and the final stored liquid effluent were collected at monthly intervals for nine months from an anaerobic digestion system operated at a 375-sow pig farm. Porcine enteroviruses were isolated on pig kidney-cell cultures, most frequently from the raw manure, and significantly less frequently from the screened digester solids, anaerobic digestion residue, and the final liquid effluent. It was concluded that the anaerobic digestion system resulted in significant, but incomplete, reductions in viral infectivity. (Author's abstract)
W88-02076

INFLUENCE OF ULTRASOUND ON THE SETTLING RATE OF FILAMENTOUS BACTERIA IN ACTIVATED SLUDGE (DER EINFLUSS VON ULTRASCHALL AUF DAS ABSETZVERHALTEN VON FADENFOERMIGEN BAKTERIEN IM BLAEHSCHLAMM),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technische Akustik.
J. Kahl, R. Germer, and M. Ziegler.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 20, No. 2, p 38-40, April 1987. 4 fig, 2 tab, 9 ref.

Descriptors: *Activated sludge, *Ultrasonics, *Settling velocity, *Biological wastewater treatment, *Wastewater treatment, Flocculation, Bacteria.

Various samples of activated sludge and a culture of Herpetosiphon were treated with ultrasound of 150 kHz and 750 kHz with a power of up to 3 W/100 ml volume and energies of up to 700 J/100 ml volume. Under this treatment the filamentous bacteria in very concentrated suspension underwent a change in structure such that the settling rate improved by as much as 20%. Destruction of cells during the experiments could be excluded. Since ultrasound technique reduces energy use and avoids destructive chemicals, it may represent a preferred methodology. (Airone-PTT)
W88-02083

REACTION MECHANISMS OF POLYCHLORINATED DIBENZO-P-DIOXINS AND POLYCHLORINATED DIBENZOFURANS DURING OZONATION OF WATER SAMPLES (REAKTIONSVERHALTEN POLYCHLORIERTER DIBENZO-P-DIOXINE UND POLYCHLORIERTER DIBENZOFURANE BEI DER OZONUNG VON WAESSERN),
Institut Fresenius Chemische und Biologische Laboratorien G.m.b.H., Taunusstein-Neuhof (Germany, F.R.).
N. Palauschek, H. H. Rump, and B. Scholz.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 20, No. 2, p 41-49, April 1987. 6 fig, 3 tab, 6 ref.

Descriptors: *Wastewater treatment, *Dioxins, *Chemical reactions, *Ozonation, *Polychlorinated biphenyls, *Chlorinated hydrocarbons, Chemical oxidation.

Polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) were degraded by ozonation in an alkaline aqueous medium, but no reaction occurred in acid solutions. Degradation rates of at least 99% were observed after the reaction conditions (pH, temperature) had been optimized. The investigated substances with three to eight chlorine atoms had different second-order reaction rates depending on their number and configuration. The selective detection and quantitative determination of PCDD- and PCDF-traces were performed by capillary gas-chromatography in combination with a mass-selective detector. (Author's abstract)
W88-02084

ISOLATION AND CHARACTERIZATION OF ACINETOBACTER STRAINS PRESENT IN THE LIQUID PHASE OF AN AEROBIC FIXED BED DIGESTER, WHILE TREATING A PETROCHEMICAL EFFLUENT,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Microbiology.
C. E. Schutte, T. J. Britz, and W. A. Joubert.
Water SA, Vol. 13, No. 2, p 57-62, April 1987. 1 fig, 34 ref.

Descriptors: *Bacteria, *Hydrocarbons, *Anaerobic digestion, *Wastewater treatment, *Acinetobacter, *Biological wastewater treatment, Anaerobic conditions, Petroleum products, Activated sludge process.

Twenty-nine gram-negative, oxidase-negative, non-sporeforming rods or diplococci, resembling Acinetobacter, were isolated from the liquid phase of an anaerobic fixed bed digester, while treating a petrochemical effluent. Six reference strains, twelve Acinetobacter strains from clinical specimens, six Acinetobacter isolates from an activated sludge process and two strains isolated from river sediments were included in the study. The similarities between the different strains were calculated using Sokal and Michener's similarity coefficient and single linkage clustering techniques. The fifty-three strains were recovered in four clusters. The Acinetobacter strains in the major cluster consisting of two large subclusters linked at or above the 93% S-level. Acinetobacter strains isolated from the anaerobic digester and from the activated sludge process were included in the same subcluster, and identified as Acinetobacter calcoaceticus var. lwoffi, while all the strains obtained from clinical specimens were clustered together and were representative of Acinetobacter calcoaceticus var. anitratus. The presence of Acinetobacter strains in the anaerobic digester indicated that these aerobic organisms had a functional role to play in the primary anaerobic digestion reactions. (Author's abstract)
W88-02087

PERFORMANCE AND MIXING CHARACTERISTICS OF AN ANAEROBIC HYBRID REACTOR TREATING A SYNTHETIC FATTY ACID CONTAINING SUBSTRATE,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Microbiology.
W. A. Joubert, and T. J. Britz.
Water SA, Vol. 13, No. 2, p 63-68, April 1987. 3 fig, 4 tab, 21 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Biological wastewater treatment, Plug flow, Mixing, Hydraulic design, Flow characteristics, Sludge bed, Performance evaluation.

An anaerobic hybrid reactor combining an upflow sludge blanket and a fixed film reactor was designed and characterized. A strict anaerobic non-methanogenic bacterial count of 10 to the 9th power viable bacteria/ml was obtained in the digester fluid. The aerobic and facultative anaerobic bacteria in the fluid gave consistent counts, of 100,000 and 1,000,000 viable bacteria/ml, over a 45 d period. Flow within the reactor was mainly of the plug flow type with a large degree of longitu-

dinal dispersion. As production did not alter the mode of flow, but decreased the dead reactor space significantly. Effluent recirculation markedly affected the COD removal efficiency and mixing characteristics of the reactor. The highest efficiency was obtained with a recirculation ratio of 6.4:1. The reactor attained a 90.0% COD reduction of the synthetic fatty acid substrate (pH 5.0) loaded at a rate of 15.0 kg COD/cu m d and at a temperature of 37 C. Recirculation improved the mixing characteristics of the reactor and changed the flow to the completely mixed type. (Author's abstract)
W88-02088

HYPOTHESIS FOR PELLETISATION IN THE UPFLOW ANAEROBIC SLUDGE BED REACTOR,
Cape Town Univ. (South Africa). Dept. of Chemical Engineering.
P. A. L. N. S. Sam-Soon, R. E. Loewenthal, P. L. Dold, and V. R. Marais.
Water SA, Vol. 13, No. 2, p 69-80, April 1987. 7 fig, 2 tab, 13 ref, append.

Descriptors: *Pelletization, *Wastewater treatment, *Methane bacteria, *Biological wastewater treatment, *Sludge bed, *Anaerobic conditions, Amino acids, Carbohydrates, Fatty acids, Hydrogen, Peptides.

Biological pellet formation in methane fermentation systems is likely only in plug flow type reactors, e.g., the Upflow Anaerobic Sludge Bed (UASB) reactor, treating carbohydrate/protein type wastes. Under this flow regime, regions of high and low hydrogen partial pressure can form. Pellet formation is mediated by Methanobacterium strain AZ, an organism that utilizes hydrogen as the sole energy source and generates all amino acids except cysteine. It is hypothesized that under high hydrogen partial pressure (substrate) conditions, with adequate supply of ammonia, a high intracellular ATP/ADP ratio is generated but the organism growth is limited by the availability of cysteine. The high ATP/ADP ratio induces an overproduction of amino acids, the excess is secreted as an extracellular polypeptide which enmeshes the organism assembly to form biopellets. Augmentation of cysteine in the feed decreases both polymer production and pellet formation. (Author's abstract)
W88-02089

MEMBRANE PROCESSES IN ENVIRONMENTAL PROTECTION (MEMBRANVERFAHREN IN DER UMWELTTECHNIK),
Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Verfahrenstechnik.
R. Rautenbach, and I. Janisch.
Chemieingenieurtechnik CITEAH, Vol. 59, No. 3, p 187-196, 1987. 14 fig, 7 tab, 35 ref.

Descriptors: *Reverse osmosis, *Wastewater treatment, *Ultrafiltration, *Process water, *Membrane processes, Separation techniques, Landfills, Environmental protection, Industrial wastewater.

Reverse osmosis and ultrafiltration are well established processes in areas like the production of fresh water from sea- or brackish water and the treatment of spent cutting emulsions from the metal working industry. New and interesting applications of these processes can be expected in environmental protection and in the treatment of process effluents. For reverse osmosis, the capacities of presently available membranes will be discussed with respect to chemical resistivity and to excludability of organic compounds. Results of experiments with various real-life systems will be reported: landfill drainage water, protein-rich process water of the fish industry, recovery of epsilon-caprolactam, solvent-contaminated wastewater. These examples demonstrate the economical and engineering potential of membrane processes in treating process effluents. These examples also demonstrate that in most cases only a combination of membrane processes and a conventional process, such as evaporation, will give optimal results. (Author's abstract)
W88-02102

DEVELOPMENT OF A CARRIER-BIOLOGICAL THREE-PHASE AIRLIFT REACTOR WITH CIRCULATING EDDY LAYER FOR INDUSTRIAL WASTEWATER PURIFICATION (ENTWICKLUNG EINES TRAEGERBIOLOGISCHEN DREIPHASEN-AIRLIFT-REAKTORS MIT ZIRKULIERENDER WIRBELSCHICHT FUER DIE REINIGUNG VON INDUSTRIEABWAESSERN),
Klaeranlagen Winter and Co., G.m.b.H., Duisburg (Germany, F.R.).
C. Oehme.
Chemieingenieurtechnik CITEAH, Vol. 59, No. 3, p 221-222, 1987. 2 fig, 16 ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Fluid mechanics, *Hydraulic geometry, *Biological wastewater treatment, Eddies, Organic compounds, Activated carbon.

The origin and main design strategy of the title reactor are described. The reactor was based on an earlier (1976) model, and enhances fluidization of the activated carbon carrier, using airlift technology in combination with a specific reactor geometry. (Airone-PTT)
W88-02103

MICROBIOLOGY OF ANAEROBIC DIGESTION,
Companhia de Technologia de Saneamento Ambiental, Sao Paulo (Brazil).
R. F. V. Novaes.
Water Science and Technology WSTED4, Vol. 18, No. 12, p 1-14, 1986. 4 fig, 3 tab, 67 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Microbiological studies, *Digestion, *Microbial degradation, Biodegradation, Biomass, Bacteria, Anaerobic bacteria, Methane bacteria, Sulfur bacteria.

A general overview is presented of studies conducted with microorganisms involved in the anaerobic digestion process, and also some ways of applying these studies as fundamental tools in the understanding, improvement and control of the anaerobic treatment of residuals. The use of various types of bacteria is described with detail given about fermentative, hydrogen producing acetogenic, homoacetogenic, methanogenic, and sulfate-reducing bacteria. (Wood-PTT)
W88-02107

GRANULATION IN UASB REACTORS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Microbiology.
J. Dolfing.
Water Science and Technology WSTED4, Vol. 18, No. 12, p 15-25, 1986. 4 fig, 23 ref.

Descriptors: *Wastewater treatment, *Sludge, *Methanogenic sludge, *Granulation, *Microbiological studies, *Upflow Anaerobic Sludge Blanket process, Microbial degradation, Biodegradation, Methanogenesis, Anaerobic bacteria, Anaerobic conditions, Anaerobic degradation, Sludge digestion.

The state of knowledge on the microbial aspects of granular methanogenic sludge in upflow anaerobic sludge blanket (UASB) reactors is reviewed. Granular methanogenic sludge was observed in a variety of upflow reactors, which is in agreement with the hypothesis that these systems select for well settling sludges. In methanogenic UASB reactors, various types of well settling sludges were observed. Microscopic and kinetic evidence suggests that acetoclastic Methanothrix-like organisms play an important role in determining which type of sludge will develop under methanogenic conditions. The mechanism of granulation still remains obscure. Extracellular material indoubtedly plays a major role as a matrix which keeps the cells together. Scanning electron microscope evidence for the presence of extracellular material is available, but transmission electron microscopy failed to validate the hypothesis that exopolysaccharides are the dominant components in this matrix. (Author's abstract)
W88-02108

MODELLING TOXIC RESPONSE OF ANAEROBIC TREATMENT,
Drexel Univ., Philadelphia, PA.
R. E. Speece, G. F. Parkin, and S. K. Bhattacharya.
Water Science and Technology WSTED4, Vol. 18, No. 12, p 27-39, 1986. 20 fig, 5 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Toxic response, *Model studies, Anaerobic conditions, Toxicity, Toxins, Structural models, Prediction.

The toxicity response of the anaerobic treatment process can be modelled from a number of different approaches. Toxicity affects the growth rate and the effluent substrate concentration and can be modeled by competitive and uncompetitive inhibition. The biological safety factor is reduced. Most toxicants exhibit reversible toxicity, which is quite significant. Acclimation is noted to some toxicants. Molecular structure can be used to model and predict toxicity. (Author's abstract)
W88-02109

NEW TECHNOLOGIES FOR ANAEROBIC WASTEWATER TREATMENT,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
L. Hulshoff Pol, and G. Lettinga.
Water Science and Technology WSTED4, Vol. 18, No. 12, p 41-53, 1986. 1 fig, 8 tab, 28 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Upflow Anaerobic Sludge Blanket process, *Sludge digestion, Granulation, Sludge, Biodegradation, Sludge seeding, Biological wastewater treatment, Technology, Anaerobic conditions.

Presently anaerobic wastewater treatment is becoming an accepted simple technology for the treatment of a variety of wastewaters. Of the different treatment systems that were developed, the UASB (Upflow Anaerobic Sludge Blanket) process has found the widest application. Almost all of the more than 60 full-scale UASB reactors in operation now are running satisfactorily. The excellent sludge retention generally found in UASB reactors is obtained by sludge granulation, which can be seen as a sludge immobilization process. The presently available insight into the sludge granulation process is briefly presented, together with the strategy to be applied for performing a proper first start-up and secondary start-up of UASB reactors, viz. using granular seed sludge. The effect of the presence of SS with regard to the loading potentials of anaerobic treatment systems will be discussed. The experiences obtained with some full scale applications of the UASB process are presented. (Author's abstract)
W88-02110

CRITERIA FOR THE UTILIZATION, DESIGN AND OPERATION OF UASB REACTORS,
Companhia de Technologia de Saneamento Ambiental, Sao Paulo (Brazil).
M. E. Souza.
Water Science and Technology WSTED4, Vol. 18, No. 12, p 55-69, 1986. 6 fig, 17 ref.

Descriptors: *Wastewater treatment, *Upflow Anaerobic Sludge Blanket process, *Design criteria, *Anaerobic digestion, Anaerobic conditions, Digestion, Biodegradation, Operating policies, Organic matter.

The principal ideas and parameters related to the application, design and operation of wastewater treatment systems using the upflow anaerobic sludge blanket (UASB) reactor are described and discussed. The differences in the process brought about by the high or low concentrations of organic material in the wastewater to be treated are pointed out in each consideration. Simple, safe and efficient UASB reactor treatment units may be developed by technicians not necessarily highly specialized in the subject. Problems which are not yet completely solved are presented in order to help in the planning of future research and devel-

opment. A number of possible questions that deal with the following subjects are discussed: (1) types of waste which can be treated by the UASB reactor, (2) concentrated wastes as from sugar-cane stillage and diluted wastes as in domestic sewage, (3) necessity of pre- and post-treatment, (4) temperature, (5) shape and dimensions of the reactor, (6) criteria and details for design, (7) start-up, operation and control of the unit, and (8) forecasts of efficiency, costs, etc. (Wood-PTT)
W88-02111

ANAEROBIC UPFLOW BED-FILTER - DEVELOPMENT AND APPLICATION,
National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
K. J. Kennedy, and S. R. Guiot.
Water Science and Technology WSTED4, Vol. 18, No. 12, p 71-86, 1986. 8 fig, 4 tab, 23 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Anaerobic Upflow Bed-Filter, *Sludge, *Model studies, Sludge digestion, Biomass, Solids, Organic loading, Waste load, Retention time, Anaerobic conditions, Filters, Granulation, Domestic wastes, Wastewater, Hysteresis, Leachates, Chemical oxygen demand.

The Upflow Sludge Bed-Filter (UBF) design provides high active biomass concentrations and long solid retention times (SRT) allowing the treatment of dilute to high strength wastes at high organic loading rates (LR) and short hydraulic retention times (HRT). The UBF system withstood severe organic shock loads and recovered within a reasonable period of time. The effect of packing material on biomass retention and characteristics, and on reactor performance was determined. A pseudo-steady state (PSS) model was developed that predicts reactor performance as a function of HRT or biomass concentration. Application of this model to step-up and step-down experiments indicated that two sets of kinetic parameters were required to account for hysteresis effects. Application of the UBF concept to the treatment of municipal landfill leachate resulted in greater than 95% COD removal at LR up to 33 kg COD/cu m/day. (Author's abstract)
W88-02112

ANAEROBIC WASTEWATER TREATMENT IN THE FOOD PROCESSING INDUSTRY: TWO CASE STUDIES,
Sao Paulo Univ., Sao Carlos (Brazil). Dept. de Hidraulica e Saneamento.
J. R. Campos, E. Foresti, and R. D. P. Camacho.
Water Science and Technology WSTED4, Vol. 18, No. 12, p 87-97, 1986. 6 fig, 2 tab, 11 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Food-processing wastes, *Industrial wastes, Anaerobic conditions, Meat processing industry, Vegetable processing industry, Fruit processing industry, Filters, Upflow Anaerobic Sludge Blanket process, Chemical oxygen demand, Organic loading, Detention time, Sludge.

Two experiments with wastewater treatment in the food processing industry were described. One of them refers to the use of an anaerobic filter (meat processing industry) and the other to the use of an upflow anaerobic sludge blanket (UASB) reactor (vegetable and fruit processing industry). In the first case, the performance of an anaerobic filter which has been working for 6 years and provides COD removal efficiency (including primary treatment) equal to or better than 80% with an organic loading of 1.4 kg of COD/cu m/day was described. The reactor has a bed of broken stones with a size of 0.75 m having a medium hydraulic detention time of 13 hours. Discharges of accumulated sludge in a false bottom below the filter are made at intervals of 2 or 3 months. In the second case, the performance of a UASB reactor (88 cu m) during 255 days of operation including the adaption phase or start-up was described. This reactor receives wastewater from vegetable and fruit processing including tomato, corn, guava, and peach. At the end of each operational phase studied, the COD removal efficiency was about 80%. In the last phase (7.5 h hydraulic detention time), the organic loading was 1.4 kg of COD/cu m/day and the hydraulic loading was 3.2 cu m/cu m/day. (Author's abstract)
W88-02113

ADVANCED REACTOR DESIGN, OPERATION AND ECONOMY,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
G. Lettinga, and L. Hulshoff Pol.
Water Science and Technology WSTED4, Vol. 18, No. 12, p 99-108, 1986. 1 fig, 3 tab, 15 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Upflow Anaerobic Sludge Blanket process, Wastewater, Design criteria, Sludge, Operating policies, Economic aspects, Suspended solids, Sludge bed.

Of all of the high rate anaerobic wastewater treatment systems, the Upflow Anaerobic Sludge Blanket (UASB) reactor has found the widest application. Therefore, attention with respect to design, operation and economy was centered on this reactor type. In designing a UASB reactor, specific attention is needed for the Gas-Solids Separator (GSS) device and the feed inlet system. For soluble wastewater, generally no phase separation is required. Pre-acidification in a separate acidification reactor can be beneficial only for wastewaters high in suspended solids. Increasing attention is given to the development of modified UASB systems, such as a combination of a sludge bed reactor and an anaerobic filter. Other possible modified UASB systems may be found in a Floating Settlement (FS) UASB reactor, the Expanded Granular Sludge Bed (EGSB) reactor, and the UASB Internal Circulation (IC) reactor. Because many factors are involved in the costs of a UASB reactor, only some rough data on reactor costs are presented. (Author's abstract)
W88-02114

DEVELOPMENT OF TECHNOLOGY FOR THE USE OF THE UASB REACTOR IN DOMESTIC SEWAGE TREATMENT,
Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
S. M. M. Vieira, and M. E. Souza.
Water Science and Technology WSTED4, Vol. 18, No. 12, p 109-121, 1986. 9 fig, 6 tab, 11 ref.

Descriptors: *Wastewater treatment, *Domestic wastes, *Municipal wastewater, *Upflow Anaerobic Sludge Blanket process, Retention time, Temperature, Brazil, Sao Paulo, Chemical oxygen demand, Economic aspects, Costs, Anaerobic digestion.

The lack of a simple and economic option for the treatment of sewage created the need to develop and make the Upflow Anaerobic Sludge Blanket (UASB) reactor adequate for low strength wastes. Therefore, a UASB reactor with a 106 liter capacity was built which was specifically designed for sewage treatment. Several tests were conducted with raw and settled domestic sewage, with only 4 hours of hydraulic retention time. This proved the reactor's technical feasibility in treating raw sewage at ambient temperature in Sao Paulo. Based on these experiments, the reactor was scaled up to 120 cu m and built for the treatment of raw sewage at ambient temperature. The operation is in its initial phase, and good COD removals are already being observed, although steady state has not yet been achieved. Since the cost of the system was extremely low, it is a feasible option for application in Brazil. (Author's abstract)
W88-02115

TECHNICAL ASPECTS AND COST ESTIMATIONS FOR ANAEROBIC SYSTEMS TREATING VINASSE AND BREWERY/SOFT DRINK WASTEWATERS,
Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil).
A. M. Craveiro, H. M. Soares, and W. Schmidell.
Water Science and Technology WSTED4, Vol. 18, No. 12, p 123-134, 1986. 3 fig, 5 tab, 13 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Industrial wastewater, *Vinasse, *Brewery wastewater, *Upflow Anaerobic Sludge Blanket process, Industrial wastes, Economic aspects, Costs, Organic loading, Chemical oxygen demand, Retention time, Capital costs, Methane.

Anaerobic digestion of industrial and domestic wastewaters is an effective way of alleviating pollution problems. The treatment of vinasse, a residue of ethanol fermentation, and brewery/soft drink wastewaters were investigated by IPT over the course of several years. The technical and economical feasibility of treating these wastewaters using Upflow Anaerobic Sludge Bed (UASB) reactors were discussed and supporting data was presented. With vinasse, it is possible to operate industrial plants with organic loading rates exceeding 15 kg COD/cu m/day, removing 95% of the initial BOD. The produced gas can be used as a substitute for diesel oil in vehicles and also to produce steam, replacing bagasse. The pay-back period of the capital investment is estimated at around 4 to 5 years. For brewery/soft drink wastewaters, it is possible to operate UASB reactors with a hydraulic retention time (HRT) of 6 hours, removing more than 90% of the initial BOD. The reactor showed a good capacity for handling temperature shocks. Capital investments for both cases are presented in terms of total investment per kg of COD and cu m of reactor installed. (Author's abstract)
W88-02116

UTILIZATION OF VINASSE EFFLUENTS FROM AN ANAEROBIC REACTOR,
Cooperative Regional dos Productores de Acucar de Alagoas, Maceio (Brazil).
F. J. C. B. Costa, B. B. M. Rocha, C. E. Viana, and A. C. Toledo.
Water Science and Technology WSTED4, Vol. 18, No. 12, p 135-141, 1986. 5 fig, 3 tab, 6 ref.

Descriptors: *Water reuse, *Aquaculture, *Effluents, *Wastewater treatment, *Anaerobic digestion, *Industrial wastewater, *Vinasse, *Fish food, Distillery wastes, Digestion, Anaerobic digestion, Primary wastewater treatment, Secondary wastewater, Organic loading, Waste load, Brazil.

An aerobic reactor was developed to biodigest alcohol distillery wastes. A further post-treatment of the effluent reduced the level of pollution to the point of eventually discharging into streams and rivers. The use of biodigested vinasse as a source of food for fish was analyzed and found to be an excellent alternative for the Brazilian alcohol industry. Very high efficiencies were obtained during primary and secondary treatment of vinasse effluent, as demonstrated by the greatly reduced organic load. (Author's abstract)
W88-02117

BIOGAS CLEAN-UP AND UTILIZATION,
Companhia de Saneamento Basico do Estado de Sao Paulo (Brazil).
E. B. Camargo.
Water Science and Technology WSTED4, Vol. 18, No. 12, p 143-150, 1986. 4 fig, 3 tab, 4 ref.

Descriptors: *Biogas, *Methane, *Wastewater treatment, *Anaerobic digestion, Cleanup, Pilot plants, Vehicular consumption, Fuel, Digestion.

The economic use of energy from biogas generated in anaerobic biodigesters installed in the sewage treatment plants owned by SABESP is described with the evaluation of its advantages in vehicular use. The clean-up process and use of biogas were designed based on results obtained from a pilot plant in operation since 1983. The biogas is sweetened through water scrubbing, with reduction of CO2 and humidity, to attain acceptable levels for consumption by vehicular engines. The resulting methane gas is deodorized and compressed in cylinders by high pressure compressors. The vehicles are adapted to compressed methane, with installation of high pressure cylinders, pressure reducing valves, methane/air mixers, valves and pressure gauge for maximum operation safety. Filling of

vehicles (refuelling) is done in an appropriate station and transfer of methane to the vehicle is by difference of pressure. (Author's abstract)
W88-02118

ANAEROBIC DIGESTION OF MUNICIPAL SOLID WASTES,
Sao Paulo Univ. (Brazil). Escola Politecnica.
For primary bibliographic entry see Field 5E.
W88-02120

SLUDGE MANAGEMENT AND IN-VESSEL SYSTEMS,
P. S. Dickens.
Biocycle BCYCDK, Vol. 28, No. 4, p 42-46, April 1987. 5 fig, 4 tab.

Descriptors: *Sludge management, *Wastewater management, *Wastewater treatment, *Sludge, *Composting, Sludge conditioning, Sludge drying, Sludge digestion, Dewatering, Economic aspects, Sludge disposal, Standards, Performance standards.

Sludge treatment and disposal account for about 50% of the costs of wastewater treatment so, in order to control treatment costs, attention must be paid to sludge management. In sludge management planning, requirements for sludge treatment, requirements for sludge disposal, and the ancillary systems needed for sludge management should be considered. Decision-making procedures regarding transportation of sludge to the disposal area, odor reduction, available site options, economic factors, alternative identification, and project recommendations were discussed. Setting performance standards for in-vessel systems involves both the biological requirements for sludge composting and the materials handling and air distribution problems. Design parameters for a range of conditions are presented. Sludge dewatering is an integral part of in-vessel sludge composting and design parameter examples are given. (Wood-PTT)
W88-02125

ANALYSIS OF EPA GUIDANCE ON COMPOSTING SLUDGE: PART IV - FACILITY DESIGN AND OPERATION,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
M. S. Finstein, F. C. Miller, J. A. Hogan, and P. F. Strom.
Biocycle BCYCDK, Vol. 28, No. 4, p 56-61, April 1987. 1 tab, 35 ref. New Jersey Agricultural Experiment Station Funded Publication D-07513-6-86.

Descriptors: *Sludge composting, *Composting, *Wastewater facilities, *EPA guidelines, *Wastewater treatment, *Design criteria, *Operating policies, Operating costs, Microbial degradation, Biodegradation.

Microbial activity affects the rates of decomposition of odor-causing material, metabolic generation of heat, vaporization of water, and production of a stabilized residue and, therefore, affects numerous practical aspects of facility design and operation of a sludge composting process. Generalizations from experience and EPA guidance on rate of microbial activity, facility design, use of a bulking agent and mechanical agitation, materials handling, land characteristics, in-vessel composting, and cost-effectiveness are compared. It was found that EPA guidance for the design and operation of wastewater sludge composting facilities do not maximize the rate of microbial activity which would promote cost-effectiveness and public acceptability. It is suggested that EPA guidance is contrary to wastewater treatment objectives, has broad negative effects, and causes federally funded facilities to be unnecessarily capital intensive and costly to operate. Correction of the situation requires that EPA guidance be firmly grounded in biological reality in order to lead to regulatory incentives to minimize capital and operating costs while improving process performance and public acceptability. (Wood-PTT)
W88-02127

THREE-COMPARTMENT PHOTOREACTOR FOR LASER ISOTOPE SEPARATION OF TRITIUM,
Institute of Physical and Chemical Research, Saitama (Japan).
K. Takeuchi, M. Motoyama, and I. Inoue.
Separation Science and Technology SSTDES, Vol. 22, No. 1, p 95-102, 1987. 5 fig, 7 ref.

Descriptors: *Wastewater treatment, *Photoreactor design, *Photoreactors, *Lasers, *Tritium, *Radioisotopes, Isotope fractionation, Isotope studies, Trifluoromethane, Separation techniques.

A new photoreactor was designed and tested for laser isotope separation of tritium using trifluoromethane as a working substance. The reactor consists of three compartments in series which are stirred efficiently with recirculation pumps independently. The CO2 laser beam is sequentially focused with BaF2 lenses serving as the beam entrance windows of the compartments. In this reactor the reaction volume is maximized while the window crystals are kept undamaged. The experimental results showed that the performance of such a reactor can be suitably predicted from the dissociation characteristics obtained from batch irradiation experiments. (Author's abstract)
W88-02128

SLUDGE MANAGEMENT IN THE UNITED KINGDOM,
WRC, Inc./Guarino Engineers Ltd., Philadelphia, PA.
For primary bibliographic entry see Field 5E.
W88-02130

SLUDGE THICKENING DOES WORK - AND SAVES MONEY,
T. Burke, and G. Hoyland.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 20, No. 3, p 23-27, May-June 1987. 4 fig.

Descriptors: *Sludge thickening, *Dewatering, *Wastewater treatment, *Mathematical models, Consolidation characteristics, Sludge volume, Differential equations, Mathematical studies, Model studies, Costs, Operating costs, Sludge disposal, Design procedures.

Sludge thickening is potentially the most cost effective process in sewage treatment since, if applied correctly, thickening can reduce sludge volume by factors of two or more thereby reducing subsequent disposal costs by more than half. The Water Research Centre, through a substantial research and development program aimed at a thorough understanding of the physical characteristics of the sludge thickening process, found that different sludges behave differently and therefore it is necessary to measure the consolidation characteristics of the particular sludge in order to design a successful thickener. A new design procedure for consolidation tanks was developed which is reliable and results in cost and operational benefits of improved sludge thickening. The basis of the procedure is a proven mathematical model which consists of differential equations solved using a computer that simulate the processes occurring in consolidating sludges. (Wood-PTT)
W88-02131

PROCEEDINGS OF THE 40TH INDUSTRIAL WASTE CONFERENCE.
Purdue Univ., Lafayette, IN.
Purdue University, West Lafayette, Indiana, May 14-16, 1985. Butterworths, Boston, MA. 1985. 1032 p.

Descriptors: *Conferences, *Wastewater treatment, *Industrial wastes, Waste treatment, Industrial waste conference, Water pollution control.

Technical papers presented at the 40th industrial waste conference concern treatment of wastes from the following industries: coal, coke, powerplants; brewery and distillery wastes; food processing; mining; steel and foundry; animals; paint, ink and dye; oil and gas fields; pulp and paper mills; dairy; plating; refineries; and metals. Other subjects include: land disposal; sludge conditioning; hazardous/toxic wastes; and biological systems. (See W88-02133 thru W88-02226) (Lantz-PTT)
W88-02132

PROCESS PERFORMANCE OF PILOT-SCALE ACTIVATED SLUDGE TREATMENT OF PRETREATED COAL GASIFICATION WASTEWATER,
North Dakota Univ., Grand Forks. Energy Research Center.
J. R. Gallagher, and G. G. Mayer.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 1-11, 13 fig, 5 tab, 11 ref. DOE Contract No. DE-FC21-83FE60181.

Descriptors: *Activated sludge, *Wastewater treatment, *Gasification, Pretreatment of wastewater, Performance evaluation, Organic loading, Process control, Suspended solids, Thiocyanates, Cyanides, Ammonia.

Pilot-scale activated sludge treatment of a pretreated gasification condensate is shown to be an effective means of reducing the organic loading of this wastewater for use as cooling tower makeup. Operation and data collection continued for over 300 days and more than (189,000) 50,000 gallons of stripped gas liquor were treated. Process stability was high as indicated by the ability of this unit to recover from a shock load (raw wastewater). Operation at longer solids retention time (SRT) (20 to 30 days) was more stable and produced the highest quality effluent. The reductions in biodegradable organics, by measurement of individual compounds, ranged from 98.7% to 100%. After a long period or operation, a limited amount of incomplete nitrification did occur. Complete removal of thiocyanate, cyanide and ammonia would require an increased hydraulic retention time combined with a long SRT (>20 days). (See also W88-02132) (Lantz-PTT)
W88-02133

CYANIDE REMOVAL IN COAL GASIFICATION WASTEWATER USING POLYSULFIDE,
Radian Corp., Austin, TX.
T. W. Trofe, and G. C. Page.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 13-22, 7 fig, 4 tab, 18 ref.

Descriptors: *Cyanide, *Wastewater treatment, *Gasification, *Polysulfides, Design standards, Coagulation, Clarification, Chemical treatment, Activated sludge, Ammonia, Thiocyanate, Organic carbon, Chemical reactions, Temperature, Hydrogen ion concentration.

Bench-scale tests were designed to provide data for developing conceptual wastewater treatment system designs. The bench-scale treatment technology evaluations included tests to evaluate the following unit operations/processes: (1) Coagulation/clarification for removal of carbon particles found in the PDU quench liquors/gas cooling condensates; (2) Chemical conversion and fixation of cyanide to less toxic forms; (3) Steam stripping for removal of dissolved acid gases and ammonia; (4) Activated sludge treatment for ammonia, thiocyanate, and organic carbon removal; and (5) Concentration of treated effluents by low temperature and high temperature evaporation processes. Major results and conclusions of the laboratory tests conducted to evaluate the treatment of cyanide with polysulfide in gasification wastewaters are summarized: (1) The reaction was found to be second order at pH 9.2 and the value of the rate constant at 22 C was 10.2/M/min; (2) The effect of temperature on the rate constant was examined to 50 C. The reaction rate doubled for every 12 C increase in temperature; (3) The reaction rate was slower at pH values less than 9 due to polysulfide-sulfur solubility constraints. Thus, pH adjustment of the wastewater may be required to achieve adequate treatment; and (4) The treatment is most applicable

to low flow/high temperature effluent streams such as stripper overheads. The following recommendations are made to better characterize the potential use of polysulfides for treating gasifier wastewaters containing cyanide: (1) Determine the functional dependency of the reaction with respect to solution pH over pH range 6-10; (2) Demonstrate feasibility of process using pilot-scale continuous backmixed reactor(s); and (3) Demonstrate treatment using wastewaters derived from other coal sources and lignites. (See also W88-02132) (Lantz-PTT)
W88-02134

TREATABILITY STUDIES FOR KOPPERS-TOTZEK COAL GASIFICATION WASTEWATER,
Tennessee Valley Authority, Knoxville.
R. R. Manner.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 23-32, 8 fig, 5 tab, 3 ref.

Descriptors: *Koppers-Totzek process, *Coal gasification, *Wastewater treatment, *Ptolemais, *Greece, Gasification, Toxicity, Nitrogenous Fertilizer industry, Alkalinity, Biological oxygen demand, Fluoride, Chloride, Boron, Ammonia, Thiocyanate, Industrial wastes, Biological treatment, Chemical treatment.

As a part of a national effort to develop synthetic fuels, the Tennessee Valley Authority (TVA) in 1979 undertook feasibility studies for a large coal gasification plant to be sited at Murphy Hill in northern Alabama. Following extensive evaluation of several coal gasification technologies, the Koppers-Totzek (K-T) process was initially chosen for the Murphy Hill plant. Since neither commercial nor pilot-scale K-T gasification facilities exist in the U.S. to date, TVA conducted a large-scale coal test at the Nitrogenous Fertilizer Industry (NFI) plant in Ptolemais, Greece, with American coal. The primary test objectives were to procure engineering data for process design and to characterize several key waste streams to evaluate environmental impacts in the U.S. and for designing pollution controls. The aqueous waste streams were characterized in detail, and following the characterization work, wastewater treatability studies consisting of biological and physical-chemical methods were initiated. The purpose of the treatability program was to ascertain that the toxic aqueous waste streams from the K-T gasification plant can be rendered environmentally acceptable for discharge. The main pollutants of concern in the K-T gasification wastewater are ammonia, thiocyanate, and cyanide. The wastewater is typically characterized to contain low alkalinity, BOD, and dissolved fluoride, chloride, and boron. However, the concentration of dissolved species is very much dependent on the coal characteristics. Ammonia concentrations up to 350 mg/L and thiocyanate concentrations as high as 200 mg/L are biotreatable without any complications. However, biotreatment is ineffective for cyanide removal. Cyanide concentrations as high as 53 mg/L can be successfully converted into less toxic iron cyanide complex prior to biotreatment and can be removed through an ion exchange process following biological nitrification and denitrification. Standard analytical techniques for measuring cyanide and thiocyanate were found by TVA to be adequate and had to be modified. Based on the results from the biological and physical-chemical treatability studies and several conventional treatment procedures, a preliminary overall effluent treatment concept was generated for the Murphy Hill plant. (See also W88-02132) (Lantz-PTT)
W88-02135

PAC-ACTIVATED SLUDGE TREATMENT OF COKE-PLANT WASTEWATER,
China Steel Corp., Kaohsiung (Taiwan). Dept. of Research and Development.
Y. M. Chao, and W. K. Shieh.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 33-41, 7 fig, 3 tab, 15 ref.

Descriptors: *Activated carbon, *Activated sludge, *Wastewater treatment, Industrial wastes, Ammonia, Process control, Chemical oxygen demand, Cyanides, Thiocyanates, Ammonia, Chemical treatment, Chemical analysis.

The China Steel's coke-plant wastewater treatment plant was designed to treat 0.76 MGD (120 cu m/hr) of coke-plant wastewater in a conventional activated sludge process. No ammonia stripping and other pretreatment are practiced. Currently, the treatment plant is receiving a combined wastewater flow of 0.76 MGD which consists of 0.51 MGD of coke-plant wastewater and 0.25 MGD of sanitary wastewater. Moreover, the amount of wastewater required for treatment will be doubled when the expansion work currently undergoing at the steel mill is completed. It is recognized that, unless the performance of the existing wastewater treatment plant is significantly upgraded, the addition of new and expensive treatment facilities is inevitable. Discussed here is a laboratory-scale investigation on the efficacy of powdered activated carbon (PAC) addition in upgrading the performance of the existing activated sludge process. The following specific conclusions are drawn from this study: (1) The treatment capacity of a conventional activated sludge process, with regard to the removal of COD, cyanide, and thiocyanate, can be doubled with the addition of PAC at a dose of 300 mg/L; (2) The adsorption of non-biodegradable COD by PAC appeared to be the main mechanism inducing an improved COD removal efficacy in the PAC units; (3) The addition of PAC stimulates the microbial oxidation of cyanide and thiocyanate in the activated sludge process. As a result the effluent ammonia nitrogen concentration is higher than that originally contained in the feed when little or no nitrification occurs; and (4) A stoichiometric relationship exists between the amount of nitrogen released from cyanide and thiocyanate via microbial oxidation and the incremental amount of ammonia nitrogen in the effluent. (See also W88-02132) (Lantz-PTT)
W88-02136

BIOLOGICAL NITRIFICATION AND HYDANTOIN REMOVAL IN COAL GASIFICATION WASTEWATER,
North Dakota Univ., Grand Forks. Energy Research Center.
C. D. Turner, P. Diepolder, and J. Strain.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 43-51, 8 fig, 6 tab, 6 ref. DOE Contract No. DE-FC21-83FE60181.

Descriptors: *Nitrification, *Hydantoin, *Coal gasification, *Wastewater treatment, Gasification, Industrial wastes, Activated sludge, Ammonia, Oxidation, Biological treatment, Nitrification, Arthrobacter, Bacteria, Nitrites, Nitrates.

The University of North Dakota Energy Research Center (UNDERC) conducts an extensive low-rank coal research program. This research includes basic coal science and issues relating to coal combustion and conversion processes. The initial objective of this research was to determine the feasibility of a two-stage activated sludge process for the biological oxidation of ammonia in coal gasification wastewater. Hydantoins, a constituent documented as being poorly or non-biodegradable, were also present in the gasification wastewater. An unexpected occurrence in this research was the biological oxidation of hydantoins during the nitrification process. The initial research objective was subsequently modified to include an evaluation of the combined removal of ammonia and hydantoins. During Phase I of the study, stable nitrification was never established. Nitrate concentrations rose and fell without changing the effluent ammonia concentration. The biological oxidation of hydantoins was identified as the most probable source of effluent nitrogen. This identification led to the systematic testing for hydantoins in Phase II. Both nitrification and hydantoin oxidation were established in Phase II of the study. The mechanism of hydantoin oxidation appears to be related to the oxidation of nitrite to nitrate. Arthrobacter was the only heterotrophic bacteria identified in the continuous flow, complete mix, stirred tank reactor (CSTR), and was found to be unable to independently oxidize the hydantoin ring. The simultaneous oxidation of hydantoins and nitrites, when combined with the fact that Arthrobacter could not degrade hydantoins, indicates that a symbiotic relationship exists between Nitrobacter and Arthrobacter. PAC addition to the CSTR in Phase II of the study may have assisted in the stabilization of the nitrification process. However, the lower concentration and variability of thiocyanate in Phase II influent may have been as significant a factor in CSTR stabilization as the PAC addition. Therefore, no definitive conclusion as to the benefits of PAC addition can be drawn from this study. (See also W88-02132) (Lantz-PTT)
W88-02137

TREATMENT OF DISTILLERY WASTEWATER (SPENT WASH) - INDIAN EXPERIENCE,
Tamil Nadu Water Supply and Drainage Board, Madras (India).
T. D. Rao, and T. Viraraghavan.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 53-57, 1 tab, 17 ref.

Descriptors: *Distilleries, *Wastewater treatment, *India, Alcohol, Molasses, Color removal, Solids, Biological oxygen demand, Wastewater lagoons, Anaerobic conditions, Odors, Aerobic conditions, Industrial wastes.

It is reported that 141 distilleries are working in India consuming approximately 2.2 million tons of molasses producing about 500 million liters of alcohol. The largest number (approximately 30) of distilleries are located in Uttar Pradesh, while 15 distilleries operate in Tamil Nadu. The phenomenal growth of the sugar industry in India resulted in an excessive production of molasses, a by-product which is used in the manufacture of alcohol. The industrial process adopted by the distilleries is nearly the same viz., fermenting the diluted molasses with yeast and distilling the alcohol produced by passing a counter current of steam while allowing the fermented wash to come down a tall column. Only about 10% of the molasses is utilized in the process, and the major remaining portion ends up as an effluent in the process. The liquid wastes from the process mainly consist of spent wash besides yeast waste sludge and floor washings. Yeast waste sludge is separated out, dried on land nearby and used as animal feed. The resulting spent wash is highly colored, high in total solids and organic matter; it has to be rendered environmentally acceptable for final disposal. This paper discusses the methods investigated, adopted and proposed for the treatment of distillery spent wash in India. Multiple anaerobic lagoon systems are widely used for treatment of distillery wastewater in India; these provide excellent BOD removal. The anaerobic lagoon systems as used in India suffer from the handicaps of lack of facilities for biogas collection and odor control; this situation can be set right be providing well engineered bulk fermenter systems of earthen construction designed with a membrane cover for biogas collection and odor control on the lines of ADI of Canada's design approach. Further studies are required to develop proper aerobic treatment techniques for the treatment of anaerobic lagoon effluent when direct discharge to a municipal sewer system or a water course is required. (See also W88-02132) (Lantz-PTT)
W88-02138

ANAEROBIC PRETREATMENT OF BREWERY WASTEWATER ON THE INDUSTRIAL SCALE,
Biothane Corp., Camden, NJ.
R. I. Sax.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 59-68, 7 fig, 2 tab.

Descriptors: *Anaerobic digestion, *Breweries, *Wastewater treatment, *Wisconsin, *Pretreat-

ment of wastewater, Industrial wastes, G. Heileman Brewery, Biothane, Sludge, Chemical oxygen demand, Sludge digestion, Methane, Chemical analysis, Biomass.

Data are presented which show that the effluent from the LaCrosse, Wisconsin brewery of the G. Heileman Brewing Company is readily treatable by means of anaerobic digestion. A Biothane wastewater treatment system employing Upflow Anaerobic Sludge Blanket (UASB) technology has been in nearly continuous operation at that brewery since late in 1981. Soluble COD removal efficiencies of about 90% are routinely achieved at volumetric loading capacities of 5 to 10 kg COD/cu m of digester volume per day and a hydraulic retention time within the digester vessel of about 6 hours. The methane purity of the generated biogas approaches 80%, and the methane yield is close to the theoretical stoichiometric quantity of 0.35 cu m/kg COD removed. The system has been shown to perform consistently despite fluctuations in day-to-day COD loading of nearly a factor of three. Normal anaerobic biomass growth within the digester occurs, and sludge losses due to washout are trivial. Some of the biomass grown in the Heileman digester has been used with great success in inoculating another Biothane full-scale system at a baker's yeast facility. Problems which have occurred fall into the category of: (1) filamentous bacterial growth; and (2) need for improvement in some ancillary equipment such as odor control and upstream solids removal. The growth of filamentous bacteria was resolved by upstream acidification to insure consumption of dissolved oxygen within the wastewater. Modifications were successfully implemented to resolve the equipment problems. It can be concluded from the experience at Heileman that brewery wastewater is an ideal candidate for efficient anaerobic treatment and that UASB technology can be applied with great success. (See also W88-02132) (Lantz-PTT)
W88-02139

EFFECTIVE TREATMENT OF WASTEWATER FROM RENDERING PLANTS,
Technische Univ., Brunswick (Germany, F.R.).
G. Frose, and R. Kayser.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 69-77, 10 fig, 1 tab, 3 ref.

Descriptors: *Wastewater treatment, *Industrial wastes, *Animal wastes, Rendering, Activated sludge, Biological oxygen demand, Chemical oxygen demand, Nitrogen, Aeration, Phosphorus, Odor.

The performance of a new, single-stage, low-loaded activated sludge plant was investigated during a one year period. The average flow was 417 cu m/d which results in a retention period of about 16 days. The average influent BOD of 2.440 mg/L was removed by more than 99%, thus leaving an effluent BOD of 10 mg/L. COD was removed by 96% (influent 4125 mg/L, effluent 155 mg/L). The average influent TKN ws 786 mg/L; the N/M-ratio varied between 7 and 17 (average about 10) g TKN/kg MLSS/d. At these low rates, nitrification was no problem. The rather good BOD/N-ratio of 3:1 and the carousel tank with its high internal recirculation made almost complete denitrification possible if aeration was controlled approximately. An automatic control based on the nitrite plus nitrate concentration of the mixed liquor was most efficient. The total nitrogen concentration of the effluent then can be kept below 10 mg/L which is more than 98% nitrogen removal. The average total phosphorus concentration was only 8.4 mg/L (BOD/P - 290). Almost no phosphorus was measured in the effluent; therefore, the phosphorus ws accumulated and absorbed by the mixed liquor, thus improving its sludge volume index from 300 ml/g after running-in to 50 ml/g after one year of operation. The withdrawal of phosphorus by the excess sludge was small because of the high sludge age of 60 to 150 days (0.27 to 0.35 kg solids produced per kg BOD applied). On the average 2300 kWh/d of electricity were consumed, which is 6.1 kWh/cu m wastewater. At maximum loads, up to 3 of the 4 aerators were in operation. It was calculated that 0.87 kWh were used per kg of oxygen respired. No unpleasant odors were emitted from the aeration tank. It was calculated that the aeration tank should be able to treat up to 3300 kg BOD/d with the same efficiency (F/M = 0.1 kg BOD/kg MLSS/d as designed). It will then be necessary to install the fifth aerator and to dose some phosphorus. In order to always achieve good conditions for nitrification (N/M in the aerobic part of the tank will be about 50 g TKN/kg MLSS/s), it might be necessary to neutralize with lime because the buffering capacity (1500 mg/L as CaCO3) theoretically today is already too low. (See also W88-02132) (Lantz-PTT)
W88-02140

EFFECTS OF SALINITY ON A RENDERING-MEAT PACKING HIDE CURING WASTEWATER ACTIVATED SLUDGE PROCESS,
Moyer Packing Co., Souderton, PA.
G. Witmayer, D. Froula, and G. Shell.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 79-86, 4 fig, 4 tab, 7 ref.

Descriptors: *Salinity, *Animal wastes, *Wastewater treatment, *Activated sludge, Industrial wastes, Moyer Packing Company, Chlorination, Dechlorination, Biomass.

Moyer Packing Company (MOPAC) is a major beef processor and renderer located near Souderton, Pennsylvania. Treatment of the wastewater generated by MOPAC's operations includes dissolved air flotation followed by a two-stage activated sludge process. The wastewater is filtered and undergoes chlorination and dechlorination prior to discharge in a small trout stream. Increased salted hide production at a high curing operation caused decreased treatment efficiency in an activated sludge process. Investigating sampling indicated that the biomass was extremely sensitive to sodium ion concentrations in excess of 1500 mg/L. Plant operations limited the amount of salt entering the plant and maintained a sodium ion concentration of 1000 to 1500 mg/L. Plant effluent quality after these modifications improved significantly. Because of discharge limitations on salinity quality and the negative effects of salinity on the activated sludge process, excess salt wastewater is evaporated. A bench scale treatability study indicated that an activated sludge biomass would fail to settle at sodium ion concentrations exceeding 30,000 mg/L as Na. The settleability observed at sodium ion concentrations below 7000 mg/L as Na compared favorably with a reference low salinity activated sludge unit. (See also W88-02132) (Lantz-PTT)
W88-02141

PILOT PLANT STUDY OF AN ANAEROBIC FILTER FOR TREATING WASTES FROM A COMPLEX SLAUGHTERHOUSE,
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
D. R. Andersen, and L. A. Schmid.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 87-97, 8 fig, 3 tab, 1 ref.

Descriptors: *Pilot plants, *Anaerobic treatment, *Wastewater treatment, *Animal wastes, Slaughterhouses, Wastewater lagoons, Odors, Filtration, Suspended solids, Methane, Industrial wastes.

Decentralization of the meat packing industry and the resultant location of many facilities in rural areas near the source of supply has necesitated that many plants provide their own waste treatment facilities. Following pretreatment to recover saleable by-products, a common treatment system consists of anaerobic-aerobic biological systems operated in a series. Traditionally anaerobic lagoons have been popular and continue to constitute an economical, simple method of reducing the waste strength prior to aerobic treatment processes. However, odor problems have been encountered at some facilities and increased energy costs have stimulated interest in recovery and use of the methane gas produced in the anaerobic process. As a result, some anaerobic lagoons have been covered. Additional modifications have been considered to increase the organic loading capacity of the anaerobic system and to provide greater stability to the process. These modifications serve to increase the concentration of microorganisms within the system by enhanced retention and/or return of microbial solids from the effluent and reduce short circuiting. In this study, a pilot-plant scale, upflow anaerobic filter was evaluated for treatment of wastewaters from a complex slaughterhouse. The pilot plant, upflow anaerobic filter provided significant reduction in the strength of wastes from a complex, beef slaughtering-breaking facility. Unit operation was similar to normal plant operation with varying waste strength, shut-downs for weekends, holidays, etc. and a degree of pretreatment (solids and grease removal). The major reduction in waste strength occurred in the lower region of the filter which contained a high concentration of suspended anaerobic solids. Biological solids build-up on the filter media provided some treatment, but the major advantages of the media are believed to be reduction of short circuiting and the associated buildup and retention of solids in the lower portion of the filter. The relatively high loading possible on anaerobic filter and the possible use of methane gas produced offer advantages for the use of an anaerobic filter for certain industrial wastes. (See also W88-02132) (Lantz-PTT)
W88-02142

WASTES FROM PROCESSING OF PHOSPHATE INDUSTRY,
Yarmouk Univ., Irbid (Jordan). Dept. of Civil Engineering.
A. B. M. Shahalam, A. R. Mansour, and M. Okur.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 99-110, 3 fig, 11 tab, 18 ref.

Descriptors: *Industrial wastes, *Phosphates, *Water pollution sources, *Wastewater treatment, *Rusaifa, *Jordan, Mining wastes, Rocks, Carbonate rocks, Siliceous rocks, Chemical analysis.

Environmental pollution from phosphate industries especially from the industries producing phosphate from natural rocks remains highly variable depending on the location and process. A literature search indicated wide variations in the contents of various chemicals associated with the natural phosphate rocks. A plant operating in Florida may produce completely different types and quantities of wastes than a plant operating in Jordan. In the Middle East, Jordan stands third following Morocco and Algeria with respect to the production of phosphates from phosphate rocks. Due to the presence of abundant phosphate rocks in the country, the phosphate industry in Jordan is bound to grow with time. Such industries are prone to create environmental problems if enough care is not taken from the beginning. Several phosphate processing industries are presently operating in Jordan: among them Rusaifa, El-Hasa, Es-Salt, Nabi Musa (West Bank) and Qatran are well known. The mineralogical and chemical analyses of low grade hard phosphate of the different beds of phosphate rocks in the Rusaifa area indicated that the phosphates are of three main types: carbonate type, siliceous type, and silicate-carbonate type. Phosphates in the area exist in four distinct layers. Layers I and II appear to be economical for mining operation at the present time. The thickness of the first and second beds are about 3 and 3.5 m, respectively. Before the installation of the processing plant, several studies and tests were performed to quantify and chemically classify the phosphate ores in the area. In these tests, the size fraction was determined from rocks crushed through normal crushers used in the phosphate processing plant. This paper contains the results of this study, directed to assess the natural phosphate rocks and pollution associated with the phosphate processing operation at Rusaifa in Jordan. (See also W88-02132) (Lantz-PTT)
W88-02143

EVALUATION OF AN ACIDIC WASTE SITE CLEANUP EFFORT,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
J. T. Novak, W. R. Knocke, M. S. Morris, G. L. Goodman, and T. Jett.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 111-120, 16 fig, 1 tab.

Descriptors: *Wastewater treatment, *Cleanup operations, *Acids, *Water pollution effects, *Piney River, *Virginia, Performance evaluation, Environmental effects, Fishkill, Acidic water, Ferrous sulfate, Copperas, Waste disposal, Disposal sites.

Waste ferrous sulfate (copperas) generated as a by-product of titanium oxide production has caused major water quality problems in several U.S. locations. This material, when contacted with water, produces an acidic stream that can have devastating environmental effects. In Piney River, Virginia, a presently non-operational titanium processing plant has created water quality problems as a result of acidity entering the Piney River. Recent specific incidences involving large-scale fish kills were reported in 1977 and 1979. In 1980, a reclamation effort was undertaken to eliminate fish kills in the Piney River. The major copperas storage pile was moved to a burial pit on the site, and the storage pile area was restored by adding lime-amended sewage sludge and seeding. Several waste storage lagoons were also drained, and the acidic deposits contained in these were also buried in the pit. In 1981, another major fishkill occurred in the Piney River. In response to this fishkill, the Virginia Attorney General's Office filed suit against past and present owners of the site. The site also became eligible for reclamation under the EPA's Superfund program. In the summer of 1983, a team of investigators from Virginia Polytechnic Institute and State University began an assessment of the site. This paper outlines the results of this study and discusses the implications of the findings. (See also W88-02132) (Lantz-PTT)
W88-02144

PROCESS AND ENVIRONMENTAL CONSIDERATIONS INVOLVED IN THE SELECTION OF HYDRAULIC AND LUBRICATION FLUIDS FOR A MODERN HOT STRIP MILL,
Stelco, Inc., Hamilton (Ontario). Water Technology Group.
C. A. Perl, T. A. Hewitt, D. L. Vice, and H. K. Miyamoto.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 121-132, 10 fig, 4 tab, 1 ref.

Descriptors: *Wastewater treatment, *Lubricants, *Oil, *Industrial wastes, *Lake Erie Works, Process control, Recirculated water, Model studies, Mathematical models, Water quality.

Lake Erie Works is situated on 1660 hectares at Nanticoke, Ontario, on the north shore of Lake Erie approximately 70 km south-west of Hamilton. It is an integrated steelmaking facility with Dock and Raw material handling systems, a Coke Oven Battery, a Blast Furnace, two Basic Oxygen Furnaces, a Slab Caster (BOSC) and a 2050 mm Hot Strip Mill. The rated plant capacity if 1.4 million tons/yr. Industrial water is supplied by the Ontario Ministry of the ENvironment (MOE) from Lake Erie. Water leaving the works is treated at the Blowdown Treatment Plant (BDTP) and discharged to a holding pond (Pond 4) which overflows to Lake Erie. The Lake Erie Works water systems were designed to minimize treatment costs and environmental impacts. For these reasons the following principles were adopted in the design process: (1) recirculate process water; (2) provide local treatment when required; (3) use existing centralized blowdown treatment plant; and (4) use up-to-date technology. As part of the Hot Strip Mill design exercise, it was necessary to establish whether the treatment facilities could deal with losses of lubricating oils and hydraulic fluids. Modeling the loss of hydraulic and lubrication fluid spills to the mill process water system proved helpful in identifying the potential 'worst case' scenarios which focus on the need for design changes and the development of emergency operating strategies to deal with them. Normal losses of working fluids to the mill process water system can significantly affect water quality. However, the continuous losses due to normally expected leakage do not present a process or environmental problem. Accidental spills of oils and high water based fluids do not present a process or an environmental problem. Accidental losses of glycols in combination with continuous glycol leaks can result in problems that will require direct operator invervention, i.e., isolate the problem quickly and if necessary shutdown operations. (See also W88-02132) (Lantz-PTT)
W88-02145

ANALYSIS AND TREATMENT OF REACTIVE WASTE: A CASE STUDY IN THE DUCTILE IRON FOUNDRY INDUSTRY,
Residuals Management Technology, Inc., Madison, WI.
T. R. Stolzenburg, L. D. Tickanen, B. E. Dudzik, J. E. Vondracek, and T. F. de Pierquet.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 133-140, 5 fig, 5 tab, 3 ref.

Descriptors: *Wastewater treatment, *Iron, *Industrial wastes, *Iron foundry industry, *Chemical analysis, Desulfurization, Slag, Gas chromatography, Mass spectrometry, Alkalinity.

Laboratory testing of calcium carbide desulfurization slag has revealed the need to develop a standard reproducible test for measuring gas generation potential and determining when the slag has been adequately treated. Solid to liquid ratio can greatly affect measured gas volumes due to the solubility of acetylene gas in water. One experimental approach to compensate for acetylene solubility is to saturate the water with acetylene before reaction with calcium carbide desulfurization slag. The test apparatus described allows slag to be added to water without loss of gas to the atmosphere. The side arm forms a gas-tight joint with the flask. For conducting gas generation tests on treated slag, the side arm design is unnecessary because little gas generation potential remains. Instead, water can be added to slag from a buret mounted in the stopper of the Erlenmeyer flask. This design is more convenient than the side arm design because the treated slag is moist and tends to stick inside the side arm. Smaller amounts of gas are generated from larger particles of slag. It is not known whether this effect is due to differences in exposed surface area per gram of slag or because of chemical compositional differences in various size fractions. In either case the heterogeneous nature of the slag dictates the use of relatively large sample sizes (> 25 g) to ensure reproducible results from sample to sample. Other gases of concern that are generated during treatment have been identified by GC-MS. (For the first time, divinyl sulfide has been reported as a treatment byproduct). These gases are present at trace concentrations, but potential effects on health and safety need to be assessed. The treatment water dissolves some of the sulfide present in the slag. Because of the alkaline nature of this water, sulfide remains in solution. However, if the treatment water is neutralized in a settling pond or wastewater treatment plant before adequate dilution has occurred, hydrogen sulfide may be generated. (See also W88-02132) (Lantz-PTT)
W88-02146

IMPROVED ALKALIMETRIC MONITORING FOR ANAEROBIC DIGESTION OF POULTRY MANURE,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
L. E. Ripley, W. C. Boyle, and J. C. Converse.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 141-149, 13 fig, 7 ref.

Descriptors: *Monitoring, *Animal wastes, *Wastewater treatment, *Poultry, *Water quality, Anaerobic digestion, Hydrogen ion concentration, Alkalinity, Chemical analysis.

The U.S. currently has approximately 280 million egg-laying hens in production, satisfying a substantial portion of the nation's protein demand. Each laying hen produces 0.25-0.33 pound of manure (feces, urine, broken eggs, feed, feathers and grit) per day - leading to a 60+ ton/day disposal problem for an average-sized farm with 500,000 birds. Anaerobic digestion of the manure prior to spreading on surrounding land could recover much of the energy which the birds do not utilize. In contrast to anaerobic digestion of swine, dairy, or cattle manure, anaerobic digestion of poultry manure has received limited attention. An organically overloaded anaerobic digester exhibits a number of symptoms which traditionally have been used to indicate a process upset. An increase in the carbon dioxide fraction of the digester offgas and/or a decrease in the digester pH result from destruction of bicarbonate buffering and volatile acids buildup. Unfortunately, neither the offgas CO2 fraction nor the digester pH changes quickly with the onset of digester stress. The two parameters most frequently used to monitor digester stability are alkalinity and volatile acids concentration; however, both parameters have drawbacks beginning with their methods of analysis. Titration of the centrifuged sample to an endpoint of pH 5.75 (PA) then to pH 4.3 (IA) makes it possible to distinguish the relative buffering contributions of bicarbonate and volatile acids in a poultry manure digester. Additionally, the intermediate alkalinity (IA) provides a semi-quantitative estimate of total volatile acids concentration. The dimensionless IA/PA (partial alkalinity) ratio is a simple, inexpensive, yet sensitive digestion monitoring tool which climbs rapidly with a process upset, and then declines with recovery. The IA/PA ratio is analogous to the VA/Alk ratio, with the advantages of not requiring measurement of VA concentrations and also not requiring precise analytical technique. The IA/PA ratio is also useful for comparison of steady-state operating configurations with successful poultry manure configurations having IA/PA values below 0.3. While the numerical values of this study may not be directly applicable to digestion of other types of waste, the double-endpoint titration and the IA/PA ratio should certainly give similar results. (See also W88-02132) (Lantz-PTT)
W88-02147

EFFICIENCY OF ELECTROCHEMICAL OXIDATION OF SULFITE AND OXYGENATION OF WATER,
Illinois Univ. at Urbana-Champaign. Dept. of Food Science.
M. P. Steinberg, T. J. Brumm, and D. L. Day.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 151-157, 7 fig, 12 ref. USDA Project No. 1-6-55546 and Grant No. 59-2171-0-2-088-0.

Descriptors: *Electrochemistry, *Oxidation process, *Wastewater treatment, *Sulfites, Animal wastes, Chemical reactions, Dissolved oxygen, Electrolysis, Aeration.

Aerobic treatment of livestock wastes can result in pollution control for both odors and pathogens. Aerobic microbial conversion can give a 90% decrease in biochemical oxygen demand and a 65% reduction in total solids. Also, production of single-cell protein, i.e., microbial solids, has been shown to be valuable as an amino-acid supplement to livestock rations. The major disadvantage of aerobic treatment is the high energy and maintenance costs of mechanical aerators. An alternative to mechanical aeration is electrolysis of water to produce oxygen and hydrogen. The commercial process is well known; however, this uses a concentrated KOH solution and the electrodes are separated by a diaphragm. In case of livestock wastes the in situ electrolysis of liquid manure by low-voltage DC electricity without a diaphragm is studied. Oxygen is used by the microbial population for aerobic respiration, while the hydrogen, being relatively insoluble in water, is released and collected as a valuable by-product. Effluent can be

used as livestock feed. Reported here is the testing oxygenation efficiencies of the electrochemical cell using a sulfite solution to deoxygenate water so that it could be reoxygenated using the electrochemical cell. The study concluded that in situ electrolysis of water is capable of satisfying microbial oxygen demand as shown by sulfite tests. Dissolved oxygen levels above that possible with air sparging and comparable to sparging with pure oxygen can be attained. Higher voltages gave higher oxygenation rates but lower efficiencies in the sulfite tests. Higher temperatures resulted in higher oxygenation rates and higher efficiencies. Using the standard sulfite-in-water test, electrolysis was less efficient than mechanical aerators, 0.25 vs. 0.91 kg O2/kWh. Electrolysis would compare more favorably in a biological process where high total solids and temperature reduce oxygen solubility so mechanical aeration is less efficient. Giving credit to the energy content of the evolved hydrogen, however, considerably improves the comparison of electrolysis to mechanical aeration on an electrical consumption basis. (See also W88-02132) (Lantz-PTT)
W88-02148

BIOLOGICAL TREATMENT OF PHENOLIC PAINT-STRIPPING WASTEWATER,
Gillette, WY.
J. H. Jeter.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 159-163, 3 tab, 4 ref.

Descriptors: *Wastewater treatment, *Phenols, *Paints, *Biological treatment, Industrial wastewater, Chromium, Zinc, Strontium, Organic compounds, Biomass.

Paint-stripping operations for control of corrosion on aircraft are performed at practically all Air Force bases. There are primarily two operations used for stripping the aircraft, spray operations and dip tank operations. Aircraft parts are either sprayed with the paint stripper, or dipped into large tanks containing stripper. The parts are then rinsed with large quantities of water. Both of these operations generate large quantities of wastewater with high concentrations of organic pollutants. Between 20,000 and 200,000 gallons of stripper laden wastewater are generated for each aircraft stripped. The coatings used on aircraft are required to be very resistant to abrasion, and are therefore very hard to remove. They usually consist of the epoxy primers with polyurethane topcoats. These coatings are very resistant to chemical strippers and require the most aggressive strippers. Strippers with 20% phenol as the active ingredient are the most effective on these epoxy-polyurethane coatings. An additive of considerable environmental concern in the stripper solution is hexavalent chromium. The resultant wastewater, high in phenol and chromium due to the chemical stripper, is further contaminated by the chromate constituents in the paints, i.e., zinc chromate and strontium chromate. The Air Force has centralized the large paint-stripping and other industrial operations into Air Logistics Centers (ALC). The paint-stripping operations are performed intermittently. The treatment of the wastewaters generated on these ALC's is a problem due to a number of factors: the variability of the flow rates from the stripping facilities, the variation in the concentrations of the toxic organic components, and the toxic or inhibitory action of the phenolic compounds. The biological treatment system developed in these projects can handle phenol concentrations of up to approximately 1500 mg/L and maintain batch removal rates, 3 g/h/cu ft. Hexavalent chromium at 20 mg/L does not affect the removal rates of this biological system as it does for commercially available biological phenol treatment systems. This system has demonstrated its stability under shock loading conditions of 3500 mg/L phenol and under starvation of several weeks duration. The system works equally well treating wastewaters generated from the spraying and dipping operations in both mild and cold climates. The continuous flow operations suggest that with no supplied aeration the reactors remove about 1000 mg/L phenol in one pass through the biomass. (See also W88-02132) (Lantz-PTT)
W88-02149

FULL-SCALE DEMONSTRATION OF TEXTILE DYE WASTEWATER REUSE,
Sverdrup and Parcel and Associates, Inc., St. Louis, MO.
J. F. Bergenthal, J. Eapen, R. V. Hendriks, A. J. Tawa, and W. C. Tincher.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 165-171, 4 fig, 2 tab, 4 ref.

Descriptors: *Wastewater renovation, *Water reuse, *Textile mill, *Dye industry wastes, Industrial wastewater, Dye concentrations, Cost analysis, Environmental protection.

The finishing of textile products in the United States is estimated to result in the discharge of over 3.8 times 10 to the 11th power liters of wastewater annually. Discharges from textile dyeing operations constitute a large fraction of this total. In 1980, approximately 3.5 times 10 to the 9th power kg of textile fibers were dyed consuming 7.8 times 10 to the 7th power kg of dyestuffs and 5.8 times 10 to the 8th power kg of auxiliary chemicals. Most of the auxiliary chemicals remain in the dye liquor and are subsequently discharged with the spent dyebath. Although most of the dyestuffs are taken up by the product being dyed, typically 5% remain in the dye liquor and are also discharged. Textile dyeing wastewater is therefore a high volume discharge containing large amounts of inorganic and organic auxiliary chemicals and is typically highly colored from the residual dyestuffs. A recent study by the U.S. Environmental Protection Agency's Air and Energy Engineering Research Laboratory examined technologies by which textile processing wastewaters could be recycled or reused, thereby reducing the amounts discharged. One of these technologies, dyebath reconstitution and reuse, was investigated in detail and was found to be an environmentally beneficial and cost-effective technology. This paper presents some of the results of that investigation. The full-scale demonstration of dyebath reuse showed that up to 10 dyeings could be performed with recycled dye liquor without affecting product quality. All carpet produced was first quality and required no additional processing above carpet dyed conventionally. Dyebath reuse resulted in significant operating cost savings. The savings were primarily a result of lower auxiliary dyeing chemical usage. Smaller savings resulted from water and energy use reductions. Because this reuse technology has a relatively low capital cost, the savings result in a short payback period, typically less than 2 years. To assist the large number of mills that could potentially use this technology, computer software and a dyebath reuse operations manual were developed. Significant environmental benefits of dyebath reuse were documented. (See also W88-02132) (Lantz-PTT)
W88-02150

EFFECT OF COD LOADING AS GLUCOSE ON CRITICAL DESIGN PARAMETERS IN LAND TREATMENT SYSTEMS,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
P. N. Coody, L. E. Sommers, and D. W. Nelson.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 173-182, 3 fig, 6 tab, 22 ref.

Descriptors: *Chemical oxygen demand, *Land disposal, *Wastewater treatment, *Glucose, Oxygen, Microbial degradation, Model studies, Organic carbon, Crops, Productivity.

The ability of a land treatment system to degrade organic C in wastewater depends on the transfer of oxygen into the soil zone of active microbial growth. Therefore, maintenance of aerobic conditions necessitates that the oxygen demand in a treatment system not exceed the maximum rate of O2 exchange by the soil. Evaluation of an O2 diffusion model to calculate maximum O2 exchange estimates of 7.3 to 11.0 Mmol O2/ha/yr depending on soil texture. However, these estimates do not account for a reduction in air-filled soil pores caused by a heavy hydraulic input and the accumulation of microbial by-products as is often encountered in land treatment systems. As a result, O2 transfer into soils used for land treatment is likely to be somewhat lower than predicted by the diffusion model, and it will likely be a function of both application frequency and amount of waste added. In many cases, researchers have attributed an observed reduction in plant growth to the depletion of oxygen in the root zone after adding oxygen demanding organics to soils. However, studies to quantify the effects of heavy COD loading on covercrop yields or soil physical properties are not readily available in the literature. The objective of this laboratory study was to quantify the effects of labile organic carbon (i.e., glucose) on physical properties and crop productivity of a simulated land treatment system. A glucose-rich synthetic wastewater was used to simulate wastewater produced in the corn processing industry and was applied to both cropped and non-cropped soil columns. (See also W88-02132) (Lantz-PTT)
W88-02151

GROUNDWATER IMPACTS FROM WASTEWATER LAND DISPOSAL SYSTEMS IN WISCONSIN,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 5C.
W88-02152

WASTEWATER TREATMENT BY SPRAY IRRIGATION, QUALITY OF EFFLUENT AND IMPACTS ON SOILS AND GROUNDWATER,
Donohue and Associates, Inc., Sheboygan, WI.
L. C. Trick, M. L. Crosser, and R. A. Geiser.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 191-201, 6 fig, 4 tab, 11 ref.

Descriptors: *Wastewater treatment, *Water quality, *Water pollution effects, *Groundwater quality, *Spray irrigation, *Wisconsin, Water reuse, Wastewater irrigation, Wastewater renovation, Food processing industry, Soil contamination, Biological oxygen demand, Pollution load, Hydrogen ion concentration, Sodium, Chemical analysis.

Krier Foods, Inc., is a food processor located at Belgium, Wisconsin, in northern Ozaukee County. They own and operate an anaerobic/aerobic lagoon system to treat 0.5 MGD of process wastewater generated at that facility and are permitted to discharge to the Belgium Drainage Ditch. Prior to July 1, 1984, the discharge limitations to the Belgium Drainage Ditch were based on guidelines for the food processing industry and were 68,200 lbs/yr total suspended solids (TSS) and 36,220 lbs/yr BOD. BOD was further limited to a maximum 100 mg/L. The present effluent limits are 20 mg/L for both BOD and TSS and are water quality based. Krier also is permitted to discharge pretreated wastewater by spray irrigation on 40 acres of land. The permitted irrigation rate is 210,000 gallons/day. The existing lagoon system produces effluent ranging from 20-100 mg/L BOD and from 20-200 mg/L suspended solids. Five alternatives were identified to allow Krier Foods to comply with the new permit limitations: (1) Lagoon modifications followed by advanced solids removal; (2) Mechanical plant followed by advanced solids removal; (3) Artificial marsh; (4) Absorption cells; and (5) Expanded spray irrigation. This study found that: (1) Spray irrigation with underdrain collection is a viable means of upgrading Krier's existing wastewater treatment system to meet advanced limits. An average hydraulic loading rate of 7,610 gallons/acre/day is achievable; (2) A tile spacing of 30 ft is the most satisfactory for the types of soils found on the Krier property. The placement of tiles must be fairly shallow to avoid intercepting the groundwater table and causing excessive dilution of treated effluent; (3) Loading rates must be decreased following the onset of cold weather to compensate for lower BOD removal kinetics in the soil and provide satisfactory tile effluent quality; (4)

Sodium in the irrigated water could cause a build-up of exchangeable sodium in the soil; and (5) Groundwater chemistry impacts are minimal; however, these impacts must be critically examined with respect to pending groundwater regulations in Wisconsin. (See also W88-02132) (Lantz-PTT)
W88-02153

SOME EXPERIENCE IN SOFTENING THE OILFIELD WATERS BY ION EXCHANGE FOR STEAMFLOOD OPERATION,
Koomey, Inc., Brookshire, TX. Engineering Dept.
J. C. T. Chen.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 225-237, 11 fig, 7 tab, 3 ref, append.

Descriptors: *Water softening, *Wastewater treatment, *Wastewater renovation, *Ion exchange, *Water reuse, *Steamflood operation, Salinity, Hardness, Oil fields, Lime, Zeolite, Dissolved solids.

Selection of viable ion exchange processes for use in softening water for oilfield steam generation is governed mainly by the total dissolved solids (TDS) of the water. These viable processes include: (1) single-stage zeolite; (2) two-stage zeolite; (3) single-stage zeolite followed by carboxylic polisher; and (4) lime soda softening followed by carboxylic polisher. Single-stage zeolite softening with downflow regeneration has been reported to be successful when the TDS of water is below 1,000 mg/L; two-stage zeolite has been operated satisfactorily where TDS of the water is below 3,000. For TDS higher than 3,000 mg/L, single-stage zeolite followed by carboxylic polisher and hot lime softening followed by carboxylic polisher has also been successfully employed. The estimated hardness leakage from zeolite softening was based on the TDS of the water nd salt dosage used for regeneration. Little information is available regarding hardness leakage attributable to the impurity of salt used for regeneration. Salt impurity becomes more critical when countercurrent regeneration of two-stage zeolite softening is utilized. Any hardness ions retained in the bottom of the resin bed will leak out during the initial normal run. The objectives of this paper are to: (1) determine the impacts of impurity salt on the softening capacity and hardness leakage from a two-stage zeolite; (2) determine guidelines and/or limitations for selecting the softening processes when treating oilfield produced water for steamflood operation; and (3) suggest certain parameters used for designing the softeners. Figures presented indicate that a water with TDS higher than 5,000 mg/L may be economically softened. It is generally accepted that zeolite softening is the most economic softening process. For steam flood application, where a hardness leakage level of 1 mg/L is required, a single-stage zeolite can be adopted for raw water with TDS less than 1,000 mg/L. Where TDS of the raw water is less than 3,000 mg/L, a two-stage zeolite softening may be effective. Raw water with TDS higher than 3,000 mg/L may also be rendered for steamflood operation provided a high quality of salt can be secured. With a very high quality of salt, raw water with TDS higher than 5,000 may be softened for steamflood application. (See also W88-02132) (Lantz-PTT)
W88-02156

THERMAL SLUDGE DRYING - A LOOK AT DRUM DRYER SYSTEMS,
Lockwood Greene Engineers, Inc., Atlanta, GA.
D. L. Russell, and D. A. Smith.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 239-251, 5 fig, 12 tab.

Descriptors: *Sludge drying, *Drum dryer systems, *Wastewater treatment, *New York, Amherst, Cost-benefit analysis, Landfills, Waste disposal, Dewatering, Solids.

Studied is a thermal sludge dewatering using an atmospheric double drum dryer, performed in early 1984 at Amherst, New York's 19 Million Gallon Per Day advanced design wastewater treatment plant. Amherst produces about 3700 tons (dry weight) of sludge per year. Sludge is dewatered 5 days/wk at a 15 dry ton day rate (60-70 wet tons at 21% solids). Sludge is dewatered using a polymer fed for preconditioning, solid bowl Sharples centrifuges and a belt press. The dewatered sludge is sent to a sanitary landfill for ultimate disposal; current disposal costs are $15.00/wet ton, down from a $37.00/wet ton cost in 1982. Current sludge dewatering and disposal costs are around $150-$175/dry ton of solids; landfilling costs represent about $75.00/ton, and polymer conditioning costs represent about $22.00/dry ton. Sludge disposal costs are artificially low because competition from a new sanitary landfill in the area has depressed tipping fees, but in the long run sludge disposal costs are expected to return to around $24.00/wet ton. Following a laboratory scale test of the sludge dewatering capabilities of the drum dryer, an in plant, two month lease of a small commercial scale drum dryer was arranged to allow the town to evaluate the equipment performance, and develop their own cost data. Sludge is fed into a pendulum feeder to distribute it evenly in the area above the rollers. The drums are rotated in opposite directions by a motor drive. Drum temperature is controlled by regulating steam pressure; adjustments are controlled on the rollers where it is scraped off by a doctor blade. By adjusting the drum speed, spacing, and the temperature of the drum (steam pressure), the operator can control the amount of water removed from the sludge and can obtain any desired degree of dryness. Once the operating parameters are set, system performance is constant, and the equipment is non-labor intensive. The money spent on energy is more than offset by the money saved by not using polymers, the beltpresses, and by hauling less solids to the landfill. (See also W88-02132) (Lantz-PTT)
W88-02157

DESIGN OF AN ENCLOSED COMPOSTING REACTOR,
Lockwood Greene Engineers, Inc., Atlanta, GA.
D. L. Russell.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 253-265, 14 fig, 3 tab, 3 ref.

Descriptors: *Waste treatment, *Composting, *Sludge treatment, *New York, *Design standards, Economic aspects, Municipal wastes, Sludge.

Much has been written about composting on a large scale using compost piles larger than 30 cu m (40 cu yd). Little has been done on development of piles of less than 7.65 cu m (10 cu yd). The smaller piles are better suited for use by small municipalities. This work was developed for a client who wanted a cheap source of potting soil to support his greenhouse and plant research activities. The original business concept was to provide a service for small municipalities enabling them to simultaneously use their treatment plant surplus manpower and reduce their sludge land disposal costs. The sludge composting project was abandoned in early 1983 after a year and a half of feasibility and full-scale tests to determine that the system could work in New York even through a severe winter. The project had several objectives, and the compost system had to meet the following criteria: low cost; simple to operate; very low maintenance; portable; low technology; environmentally non-objectionable; meet EPA compost sterility requirements; reusable equipment; and dry, odor free, end products. In this research work it was found that sealing the pile into an insulated reactor makes small scale composting practical by reducing material handling and nuisance vector problems. The use of farm equipment for loading the pile and the fabrication of the pile housing make the composting system non-capital and non-labor intensive and also suitable for a small municipality. Finally, the different operating system using two tiered positive ventilation satisfies current State and Federal criteria for pathogen kill and reduces the overall system composting time. (See also W88-02132) (Lantz-PTT)
W88-02158

HYBRID BIOLIQUEFACTION AND BIOGASIFICATION FOR PAPAYA PROCESSING WASTES IN THE TROPICS,
Hawaii Univ. at Manoa, Honolulu. Dept. of Agricultural Engineering.
P. Y. Yang, and C. Y. Chou.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 267-277, 8 fig, 6 tab, 17 ref.

Descriptors: *Wastewater treatment, *Biogasification, *Papaya, *Food processing industry, Gasification, Industrial wastes, Chemical oxygen demand, Anaerobic digestion, Fermentation, Methane.

Anaerobic fermentation of fruit processing wastes holds potential for producing alternative energy in addition to reducing the pollution problems. The biogas (50-70% of methane) produced from the anaerobic fermentation of fruit processing wastes could have been used in equipment designed for natural gas fuel with no or only minor purification . In order to utilize this potential, the anaerobic fermentation of papaya processing wastes was preliminarily studied and reported in Hawaii. It has been indicated that the biogasification of papaya processing wastes for pollution control and energy utilization is feasible. Also, the biogasification process with sludge recycling permits smaller reactor volume without any deterioration of methane production rate and methane content. Combined liquefaction and gasification treatment of organic residues were investigated with various solid agricultural and industrial organic residues including straw, grass, cabbage leaves, waste-onions, sugar-beet pulp, cannery wastes, tomato-plant wastes, municipal solid wastes, etc. This combined system offers a significant advantage by eliminating the post-handling and treatment of the digested effluent and is free of the drawbacks of the dry anaerobic fermentation (i.e., requirement of a long reaction time to stabilize the organic residues). The optimum organic loading rates for maximizing organic removal efficiency and methane production for treatment of papaya processing wastes in the tropics are 1.27 and 4.75 gm TCOD/L/day, respectively. One day of soaking period with the anaerobically digested effluent is required for the preparation of raw papaya processing waste. Compared with an anaerobic fermentation process with sludge recycling and other similar hybrid system treating organic solid waste, the present system is comparable in performance based on COD removal and methane production and simpler in construction and operation. Furthermore, the elimination of post-processing handling and treatment of the digested effluent can be achieved. (See also W88-02132) (Lantz-PTT)
W88-02159

IMPACTS OF MULTI-JURISDICTIONAL AGREEMENTS AND EFFLUENT DISPOSAL BY CITRUS IRRIGATION ON THE DEVELOPMENT OF AN INDUSTRIAL WASTE PRETREATMENT PROGRAM,
Boyle Engineering Corp., Orlando, FL.
For primary bibliographic entry see Field 6E.
W88-02160

DESIGN AND OPERATION OF WET CORN MILLING PRETREATMENT FACILITIES,
Daniel International, Greenvale, SC.
L. M. Lace, C. H. Huether, M. Tepoorten, and H. H. Trayner.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 287-295, 3 fig, 7 tab, 6 ref.

Descriptors: *Wastewater treatment, *Food processing wastes, *Wastewater facilities, *Pretreatment of water, *Ontario, Canada Starch Company, Suspended solids, Biological oxygen demand, Aerated lagoons, Aeration, Chemical oxygen demand.

Five months prior to process plant start-up of the Canada Starch Co., Inc. (CASCO), Port Colborne, Ontario, Wet Corn Milling plant, Canada Starch

was notified by the Municipal Authorities that the municipal wastewater treatment plant was unable to treat the plant wastewater as originally permitted. Pretreatment requirements limiting discharge to 500 mg/L BOD and suspended solids (SS) were imposed. In addition there was substantial concern by the authorities that the impact of high carbohydrate wastewater on the municipal plant would cause an unacceptable decrease in effluent quality due to the increased presence of filamentous organisms characteristic of the sludge. The pretreatment plant design consists of neutralization of process wastes followed by aeration of all wastes with partial solids settling followed by sampling prior to discharge to the regional wastewater treatment plant. Two reactors each having a volume of 19 L were used to simulate the two CASCO aeration lagoons. The aeration reactors were aerated using diffused air and were operated in series. Wastewater was pumped to the first lagoon (Reactor 1) from a supply tank, and effluent from it flowed by gravity to the second. Effluent from the second lagoon (Reactor 2) overflowed and was pumped to the 'city' activated sludge reactor (Reactor 3). The system operates well until choked with solids in the second lagoon at which time solids carryover becomes a problem unless the basins are cleaned. COD removal efficiency in the Lagoon System is lower than anticipated (78%) due to loading variations while the solids production rate is higher than anticipated. Solids settling is difficult, and more often than not, the effluent suspended solids exceeds the 200 mg/L operating level desired. That efficiency of summer operation falls off is attributed to shock loading and wide swings in loading rate. Overall treatment efficiency is not significantly different between single cell operation and dual cell operation. It appears that the major impact of the CASCO discharge on the municipal plant is in terms of solids loading as the solids handling facilities are operating at capacity. (See also W88-02132) (Lantz-PTT)
W88-02161

FULL SCALE ANAEROBIC-AEROBIC BIOLOGICAL TREATMENT OF A SEMICHEMICAL PULPING WASTE WATER,
Sociedad Anonima Industrias Celulosa Aragonesa, Zaragoza (Spain).
A. A. Velasco, B. Frostell, and M. Greene.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 297-304, 13 fig, 6 tab, 7 ref.

Descriptors: *Wastewater treatment, *Biological treatment, *Pulp wastes, *Anaerobic digestion, *Aerobic treatment, *Spain, Chemical treatment, Zaragoza, Pulp and paper industry, Chemical oxygen demand, Biological oxygen demand.

AC Biotechnics - formerly AB Sorigona - has been deeply involved in anaerobic treatment of pulp and paper mill effluents since 1980. Six pilot plant studies have been carried out and three full scale plants are presently in operation. One of these full scale plants is located at the SAICA semichemical pulp and paper mill in Zaragoza, Spain. It was started up in late April, 1984 and has received full flow from the mill since August, 1984. In this paper, the SAICA mill and the results achieved in the SAICA ANAMET plant are presented. An examination of the treatment results during the period evaluated shows that there has been a decrease in COD reduction and a lowered methane yield with time. Four different factors may have contributed to this change: an increased flow, a decreased temperature, work on the lamella thickener, and a change in wastewater characteristics. The characteristics of the waste may have had an influence on the observed differences in COD reduction during the period evaluated. Thus the COD/BOD5 ratio of the influent has varied, considerably. From being 2.0-2.7 during the first months, it increased to 3.5-3.7 during a part of the evaluation period. A higher COD/BOD5 would indicate a more refractive waste and would result in a lowered COD reduction despite a very high BOD reduction just as is indicated in the presented results. The results achieved in the SAICA ANAMET plant so far have exceeded expectations set for it. During more than half a year of continuous operation, enough data have been collected to state that anaerobic-aerobic treatment of this wastewater is a technically very attractive way to reduce pollution and, at the same time, convert a substantial amount of influent organic material to a useful natural gas substitute. The average results during the period investigated are summarized. (See also W88-02132) (Lantz-PTT)
W88-02162

REMOVAL OF COLOR FROM KRAFT PULP MILL EFFLUENT,
Tennessee Technological Univ., Cookeville. Dept. of Civil Engineering.
K. L. Roberts, and J. Schoolfield.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 305-316, 4 fig, 7 tab, 23 ref.

Descriptors: *Color removal, *Wastewater treatment, *Pulp wastes, Pulp and paper industry, Lignin, Alum, Sludge, Industrial wastes.

Pulp and paper mill wastewater is intensely brown colored by lignin, which is a byproduct of the pulping process. The brown color of pulp mill waste is not affected by secondary biological treatment used to remove most of the other pollutants from pulp and paper mill wastewater. When it is discharged into the environment, lignin can, under the right conditions, cause severe damage. Despite years of research by the pulp and paper industry, there is still no method of color removal which is economical and effective. This paper contains the results of an experimental verification and optimization of a color removal method which has been developed over a period of several years. It is based on the use of a class of cationic surfactants called quaternary ammonium compounds (quats) to destabilize lignin molecules and remove them from solution. Various mixtures of alum/quat removed almost 100% of the color from Kraft pulp mill waste. When the treatment reduced the true color below 20 units, the sludge volumes were extremely high. A narrow range of alum/quat dosages, centered around 200/1300 mg/L alum/quat, produced acceptable residual true color concentrations (about 40 units) while also producing sludges which settled rapidly into relatively small volumes. The combination alum/quat treatments produced sludges which, for the most part, had specific resistance values which were on the low end of the typical range for alum and biological sludges. The combined dose of 200/1100 mg/L alum/quat was the optimum based on a consideration of all factors. None of the sludges responded to flotation as a separation mechanism. (See also W88-02132) (Lantz-PTT)
W88-02163

BIOKINETIC MODELS TO OPTIMIZE AERATED STABILIZATION BASINS,
Brown and Root Development, Inc., Houston, TX.
Y. M. Mehta, and R. L. Stephenson.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 317-323, 6 tab, 6 ref.

Descriptors: *Model studies, *Biokinetic models, *Anaerobic stabilization basins, Aeration, Pulp and paper industry, Mathematical models, Eckenfelder's First Order Model, Lawrence and McCarty Model, Exponential Model, NCASI Dynamic Model, Performance evaluation, Computers.

Aerated Stabilization Basin (ASB) is a common and popular unit process for the treatment of paper mill wastewater in North America. A situation already faced by several mills, and one which can be anticipated to occur more frequently in the future, is the desire to upgrade effluent quality as a result of raw waste load increases resulting from incremental production increases, without major expenditures on the existing treatment facilities. Numerous mathematical models are available to evaluate the performance of ASBs and for use in predicting the performance of ASBs when operating and/or loading conditions are changed. The dilemma is which model to use in making predictions of treated effluent quality and when investigating changes in operating conditions as all give slightly different results. This paper gives the results of the investigation of four different models as applied to three different ASBs and presents a discussion of the advantages and disadvantages of each model. The four models that were analyzed are: Eckenfelder's First Order Model, Lawrence and McCarty Model, The Exponential Model, and The NCASI Dynamic Model. Eckenfelder's model performed well for all three ASBs. The Exponential model and Lawrence and McCarty's model performed well for two ASBs. The NCASI model performed well for the only ASB it was applied to despite the fact that only four calibrating runs were made. Eckenfelder, Exponential, and Lawrence and McCarty's models are steady state models and calculations comparing them can be performed by hand or on a personal computer. The NCASI model is a dynamic model and requires a mainframe computer. The NCASI model can be used to model spills, nutrient limitations, etc., and would be the model of choice when daily results or spill modeling are required. The NCASI model is very expensive to run. (See also W88-02132) (Lantz-PTT)
W88-02164

BENTHAL INTERACTIONS IN A KRAFT MILL WASTEWATER LAGOON,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
M. R. Collins, Z. K. Chowdhury, and C. W. Bryant.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 325-333, 11 fig, 2 tab, 6 ref.

Descriptors: *Benthic zone, *Wastewater treatment, *Kraft mills, *Wastewater lagoons, Aeration, Biological treatment, Seasonal variation, Biomass, Solids, Nitrogen, Phosphorus.

The performance of an aerated stabilization basin (ASB) is affected by the influent properties, the kinetics within the liquid layer, and the physical and biological processes in the benthal zone. This paper describes the impact of the biological processes within an operational Kraft mill lagoon. Processes within the benthal zone result in the solubilization of organic solids and the subsequent stabilization or feedback of the soluble products. The total oxygen demand of the benthal solids may be: (1) exerted as a direct demand in the aerobic zone; (2) transported to the overlying water column as a soluble feedback; (3) averted by methane production in the anaerobic zone; or (4) stored within the benthal deposit. The relative importance of these mechanisms has been proposed to vary with organic loading and temperature. Conditions in the benthal deposit varied dynamically with each season. Changes in the effluent properties and the size of the effective settling zone were more significant than temperature-induced changes in benthal kinetics. Poor effective settling of biomass solids within the lagoon was the primary mechanism causing a reduced benthal loading of volatile solids during the winter. Data from core samples also varied with the season. The pattern of change in benthal nutrient content was consistent with that developed from mass balances across the lagoon. However, the measured changes in volatile solids content did not conform to the pattern predicted by the mass balances. A consistent spatial variation in benthal nitrogen, phosphorus, and volatile solids was observed in all seasons. The content of volatile solids and nutrients increased with distance from the influent and with distance from the primary stream path. During the past four years of operation, benthal storage has removed 20% of the lagoon volatile solids, 16% of the nitrogen, and 28% of the phosphorus. However, the average values do not reflect significant changes over the past year. During that period, nutrient storage increased by 500% and volatile storage decreased by 46% in the top portion of the deposit. (See also W88-02132) (Lantz-PTT)
W88-02165

PILOT-SCALE ANAEROBIC TREATMENT OF PEROXIDE BLEACHERY WASTE, PAPER MACHINE EFFLUENT AND WASTE ACTIVATED SLUDGE,
ADI Ltd., Fredericton (New Brunswick).
A. A. Cocci, R. C. Landine, G. J. Brown, and A. M. Tennier.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 335-341, 7 fig, 3 tab, 1 ref.

Descriptors: *Wastewater treatment, *Anaerobic treatment, *Peroxides, *Bleaching wastes, *Activated sludge, Pulp and paper industry, Filtration, Pilot plants, Methane, Chemical oxygen demand, Biological oxygen demand, Biodegradation.

In mid-1984 ADI International Inc. was commissioned by a pulp and paper mill in the North Central United States to carry out a five-month pilot-scale anaerobic treatability study. This followed a successful six-week bench-scale study in which the treatability of bleachery waste (BW) and paper machine effluent (PME) was assessed. The anaerobic technology chosen for the pilot study was an ADI-BVF (bulk volume fermenter); this choice was made over the high-rate downflow filter. The objectives of the pilot study were to confirm earlier bench-scale results showing treatability of the bleachery waste and pulp mill effluent and to establish full-scale design criteria so that full-scale capital and annual costs could be estimated. The ADVI-BVF was found to be well suited for treatment of peroxide bleachery waste, paper machines effluent, and waste activated sludge (WAS) provided the peroxide residual of the BVF influent is 8 mg/L or less. An effective method of peroxide neutralization is to mix WAS and bleachery waste and hold for approximately 6 to 8 hours before treatment. The biogas produced is a high-quality fuel gas (68% methane) and the specific methane generation rate averaged 0.33 cu m CH4 (STP)/kg COD removed. Because of the high solids loading, a BVF HRT of seven days is proposed. The projected full-scale BVF performance is approximately 80% BOD and COD removal and at least 90% suspended solids removal. An ample supply of nutrients for proper BVF operation will be available from the digesting WAS. Little, if any, chemical is required for BVF pH control if WAS is digested. (See also W88-02132) (Lantz-PTT)
W88-02166

EVALUATION OF A WASTEWATER TREATMENT PROCESS BY A NEW TECHNIQUE,
Idaho Univ., Moscow. Dept. of Chemical Engineering.
M. L. Jackson.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 343-349, 1 fig, 1 tab, 10 ref.

Descriptors: *Wastewater treatment, *Performance evaluation, *Process control, Mathematical studies, Aeration, Flotation, Biological oxygen demand, Temperature.

Equations are presented which permit the use of phase analyses of a biological process for the determination of oxygen transfer efficiencies, volumetric transfer factors, alpha values, and desorption of gases from liquids for flotation. Concentrations of oxygen, nitrogen and carbon dioxide in the molecular state were determined using a new technique of sample equilibration in combination with a gas chromatograph. The analyses and equations have been applied a complete mix activated sludge process, the deep tank aeration/flotation (DTA/F) system, where reliable samples of gases and liquids can be obtained. A pulp/paper mill is expanding production which will increase the BOD waste load on the existing DTA/F treatment system. A study was undertaken to evaluate the potential of the present system to treat the loading at increased mill production. The system has been meeting discharge requirements over the past eight years. Recent modifications of the process include operating at an elevated temperature of 48-51 C and at near zero dissolved oxygen in the bulk tank liquid. Initial data demonstrate the application of the equations and techniques developed. Performance of the system confirms the increased oxygen transfer and BOD utilization expected. (See also W88-02132) (Lantz-PTT)
W88-02167

DAIRY PROCESSING WASTEWATER BIOAUGMENTATION - AN EVALUATION OF EFFECTIVENESS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
J. H. Martin, and R. R. Zall.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 351-360, 4 fig, 7 tab, 11 ref.

Descriptors: *Dairy industry, *Wastewater treatment, *Biological treatment, Performance evaluation, Organic compounds, Hydraulic retention time, Solids retention time, Suspended solids, Microorganisms, Dissolved oxygen, Sludge, Bulking sludge.

In view of the potential benefits that bioaugmentation could provide to the dairy industry, a series of laboratory studies were initiated to critically evaluate this practice. Described and discussed here are the results obtained from one of these studies. Originally, this study was to have two phases. The objective of the first phase, which was completed, was to evaluate the effectiveness of bioaugmentation under steady-state conditions of constant organic and hydraulic loading. The objective of the second phase was to evaluate the effectiveness of bioaugmentation under non-steady-state conditions with randomly varying organic loading which was to have created conditions favorable to the proliferation of filamentous microorganisms and bulking. For reasons that will become apparent, the second phase of the study was never initiated. In this study, the following standardized method of reactor operation was employed. All of the reactors were operated in a draw and fill mode at a constant hydraulic retention time (HRT) of five days without recycle. Thus, hydraulic and solids retention times (SRT) were equal. It was decided to operate these reactors without solids recycle in order to eliminate changes in mixed liquor suspended solids concentrations due to high solids losses via clarifier overflow, a possible additional variable. Effluent withdrawals and influent additions were made daily as were the bacterial culture additions to the bioaugmented reactors. The bacterial culture additions were made immediately following the influent wastewater. The results of this study appear to confirm previous observations that the proliferation of filamentous microorganisms in the treatment of dairy processing wastewaters can be triggered by short-term depressions in mixed liquor dissolved oxygen concentrations following periodic waste additions. Neither of the commercially available bioaugmentation cultures used were effective in preventing this proliferation and the resulting development of sludge bulking from occurring. It appears that the best approach for improving the reliability of the activated sludge process for the treatment of these wastewaters is not bioaugmentation but rather more precise process control (See also W88-02132) (Lantz-PTT)
W88-02168

TREATMENT OF DAIRY WASTEWATER BY THE ANAEROBIC UP-FLOW PACKED BED REACTOR,
Northeastern Univ., Boston, MA. Dept. of Civil Engineering.
R. C. Backman, F. C. Blanc, and J. C. O'Shaughnessy.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 361-372, 10 fig, 5 tab, 7 ref.

Descriptors: *Dairy industry, *Wastewater treatment, *Anaerobic digestion, *Packed beds, Chemical oxygen demand, Filtration, Bacteria, Hydrogen ion concentration, Suspended solids, Alkalinity, Industrial wastes, Volatile acids.

The anaerobic filter process has been shown to overcome the aerobic disadvantages because: (1) no energy is needed for oxygen transfer; (2) high COD removal efficiencies can be achieved when operating at high organic loading rates (in excess of 10 kg COD/cu m/day); (3) anaerobic filters can be operated intermittently without losing the ability to regain efficient treatment; (4) shock loads can be accepted as long as sufficient buffering capacity is available to maintain at pH level suitable for methanogenic bacteria; and (5) low net production of biological solids in an anaerobic filter yields less residual sludge. This occurs because of long solids retention time. The purpose of this study was to evaluate the ability of up-flow packed bed reactor (UPBR) operating in the mesophilic temperature range (35 C) to treat a dairy wastewater containing greater than 95% biodegradable solids. Operational parameters varied were hydraulic retention time and substrate concentration. Waste characteristics measured throughout the study were COD, BOD, pH, alkalinity, biogas composition, biogas production rate, volatile acids, and total and volatile suspended solids (VSS). Also flow regimes were characterized for conditions before inoculation and when the reactors were considered at a biological equilibrium condition. The study showed that the anaerobic UPBR was capable of reducing COD and VSS efficiently. An organic loading rate of 5 kg TCOD/cu m/day seems to be the limit for effective treatment. (See also W88-02132) (Lantz-PTT)
W88-02169

SLUDGE BULKING CONTROL FOR HIGHLY DEGRADABLE WASTEWATERS USING THE CYCLIC ACTIVATED SLUDGE SYSTEM,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
M. C. Goronszzy, W. W. Eckenfelder, and J. E. Cevallos.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 373-381, 7 fig, 4 tab, 22 ref.

Descriptors: *Bulking sludge, *Wastewater treatment, *Activated sludge, Biological treatment, Dairy industries, Flocculation, Sorption, Biological oxygen demand, Specific oxygen utilization rate.

The treatment of dairy wastes in a cyclic activated sludge system configured and operated to enhance the growth of floc-forming organisms is reported upon. In this system floc-loading conditions are generated which maximize the initial uptake and utilization of soluble substrate from the waste thus creating an environment which minimizes the growth of filaments. Additionally, the biomass is exposed to alternating aerobic-anoxic periods and the feeding pattern is arranged to impact in a quasi batch mode. Three known protocols for sludge bulking control are thereby introduced simultaneously into this single basin method of treatment. In all cases there is a high initial concentration of substrate in microorganisms (floc-loading) in the reactor configuration. The number of reactors sized into the system is dependent on the initial waste strength and the level of treatment that is desired. Initial biosorption through selective floc-loading conditions is maximized in order to prevent competitive growth of filamentous microorganisms. Alternating aerobic-anoxic periods and a quasi batch feeding pattern further mitigate against the growth of filaments. Two full-scale plants have been described in which BOD reduction from 1200 mg/L and 2350 mg/L to less than 20 mg/L and 30 mg/L is achieved, respectively. Laboratory studies using a glucose yeast extract waste were used to simulate floc-loading conditions experienced in the full-scale plants. (See also W88-02132) (Lantz-PTT)
W88-02170

POLLUTION CONTROL THROUGH BY-PRODUCT RECOVERY USING HYPERFILTRATION. CASE STUDY OF A SPECIALTY CHEESE PRODUCER,
Schmidtke (Norbert W.) and Associates Ltd.,

Kitchener (Ontario).
N. W. Schmidtke, and D. W. Bissett.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 383-398, 12 fig, 8 tab, 9 ref.

Descriptors: *Water pollution control, *Wastewater treatment, *Case studies, *Cheese, *Food processing wastes, *Quebec, Whey, Filtration, Solids, Hyperfiltration, La Fromagerie d'Oka.

Sweet whey is rich in protein, lactose, minerals, amino acids and vitamins and thus it is a significant source of feed-stock suitable for a variety of end-uses. On the other hand, sweet whey represents a significant pollution potential as illustrated in context with pollution parameters. The successful handling of whey dictates that a management strategy embodying by-product recovery and pollution prevention be devised. It is usually the smaller cheese plant operator (< 11,000 kg/cheese/day) who has difficulty in finding a cost-effective solution to the whey management problem. One management approach applies the principles of pollution control and resource recovery and involves application of hyperfiltration for concentrating the whey solids. This paper reports on observations and experiences during a long-term sweet whey solids hyperfiltration demonstration study at a small specialty cheese producing plant in the province of Quebec, Canada (La Fromageragie d'Oka). The manufacturer's claims of being able to concentrate solids from 6% to 24% at a mean permeate flux of 12 L/sq m/hr are supported. Based on 1983 dollars, the cost of concentrating sweet whey solids from 6% to 24% is 46 cents/kg of solids recovered. Optimum operating conditions for concentrating whey from 6% to 24% were identified to occur at a system pressure of 3700 kPa over 11.2 hours. The pollution potential of 14,200 p.e. from La Fromagerie d'Oka can be reduced to 450 p.e. through application of hyperfiltration technology. (See also W88-02132) (Lantz-PTT)
W88-02171

SCALE-UP OF THE MEMBRANE ANAEROBIC REACTOR SYSTEM,

Dorr-Oliver, Inc., Stamford, CT.
A. Y. Li, and J. J. Corrado.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 399-404, 5 fig, 4 tab, 5 ref.

Descriptors: *Anaerobic digestion, *Membrane processes, *Reactor systems, *Wastewater treatment, *MARS, Biomass, Stabilization, Ultrafiltration, Membrane Anaerobic Reactor System, Chemical oxygen demand, Biological oxygen demand.

The Membrane Anaerobic Reactor System (MARS) is Dorr-Oliver's patented anaerobic process for treatment of ultra-high strength industrial wastewaters (COD > 20,000 mg/L). It utilizes a suspended growth reactor coupled with Dorr-Oliver's IOPOR ultrafiltration membrane modules which provide positive biomass retention and essentially particulate-free effluent. In the MARS system, acidification and methane fermentation take place simultaneously in a single-state anaerobic reactor. Following anaerobic stabilization, the reactor contents are pumped to the membrane unit for solid-liquid separation. The biomass is returned to the reactor, and the permeate becomes the effluent. The MARS system can be scaled up from a small pilot plant to a demonstration plant 200 times larger in reactor size. Process control parameters for the biological systems used in MARS pilot plant operation, such as volumetric loading, F/M ratio and SRT, can be effectively applied in the demonstration plant resulting in the same reactor VSS concentration and similar sludge yield. The effluent quality in the larger-scale plant was much better in terms of organic compositions (COD of 305 and BOD of 257 mg/L) as compared to that in the smaller pilot plant (COD of 1565 and BOD of 1075 mg/L). The improved effluent quality during scale-up is believed to be due to less shear on the reactor biomass by the membrane unit. The observed or net biomass yield and the observed methane yield were found to be identical for both large and small plants (0.059 kg VSS/kg COD removed and 0.30 cu m CH4/kg COD removed, respectively) indicating no impact on biomass and methane yields during the scaling up of the MARS system. Ultrafiltration membrane performance in terms of membrane flux for the commercial cartridge ultrafiltration station was in excellent agreement with the pilot plant Series 'S' ultrafiltration unit. Better instrumentation in the commercial-size allowed tighter control of the operation resulting in a better correlation between membrane flux and reactor VSS concentration. (See also W88-02132) (Lantz-PTT)
W88-02172

NITROGEN TRANSFORMATIONS AND REDUCTION BY RIDGE AND FURROW LAND TREATMENT OF DAIRY WASTE,

Foth and Van Dyke and Associates, Inc., Green Bay, WI.
F. J. Doran, D. K. Sauer, W. C. Boyle, and P. M. Berthouex.
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Descriptors: *Fate of pollutants, *Nitrogen removal, *Ridging, *Furrows, *Land disposal, *Dairy industry, *Wastewater treatment, *Wisconsin, Biological oxygen demand, Sand, Loam, Leaching, Ammonia, Nitrogen compounds, Percolation, Denitrification.

In Wisconsin, there are 83 dairies, four meat packers, a rendering plant, and a pet food manufacturer which use ridge and furrow treatment. Site areas range from 0.1 to 56 acres. The three advantages in selecting this treatment process are: (1) ease of operation; (2) low capital and operation/maintenance costs; and (3) year around operation. Presented here are the results of a study supported by the Wisconsin Department of Natural REsources (WDNR) and conducted at two ridge and furrow sites treating cheese processing wastewater. Site A receives 39,000 gallons/day (GPD) and is located on 4.7 acres of sandy soil. Site B receives 14,000 gpd and is located on 3.0 acres of silty loam soil. Sixty-six to 69% nitrogen losses were observed in nitrogen budgets around the unsaturated zones at both ridge and furrow systems. These were attributed to denitrification. Leaching accounted for the fate of 34% and 13% of applied nitrogen at Site A and Site B, respectively. Plant uptake losses accounted for 0% and 18% of applied-N at Site A and Site B, respectively. The wastewater nitrogen at both sites was mainly organic-N. Much of this organic-N was contained in the suspended solids and settled in the furrows where it was transformed into dissolved ammonium. Dissolved ammonium was the primary form of nitrogen in the furrow wastewater. As the ammonium percolated into the unsaturated zone, nitrification occurred within 3 to 3.6 feet at Site A and within 1.5 feet at Site B. The oxygen demand imposed by the wastewater did not inhibit this transformation. Denitrification of this nitrate was observed below the 3 to 3.6 foot depth at Site A and through the entire unsaturated profile at Site B. Nitrogen reductions were dependent on the soil's infiltrative capacity which affected travel times, wastewater distribution efficiency, and the load/rest cycle. (See also W88-02132) (Lantz-PTT)
W88-02173

NICKEL REMOVAL FROM NICKEL PLATING WASTEWATER USING IRON, CARBONATE, AND POLYMERS FOR PRECIPITATION AND COPRECIPITATION,

Alabama Dept. of Environmental Management, Montgomery.
F. McFadden, L. Benefield, and R. B. Reed.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 417-429, 7 fig, 8 tab, 16 ref.

Descriptors: *Nickel, *Wastewater treatment, *Metal-finishing wastes, *Iron, *Carbonates, *Chemical precipitation, Hydrogen ion concentration, Polymers, Regression analysis, Costs.

Nickel removal using hydroxide is most efficient for the synthetic wastewater at pHs 10 and 11 depending on the iron:nickel ratio and total carbonate concentration. For example, both soluble and total nickel at pH 10, iron:nickel = 2, and total carbonate (C sub T) = 0 was reduced to <0.10 mg/L. These same results occurred at pH 11, iron:nickel = 2, and C sub T = 100 mg/L as CaCO3. At pH 10 the soluble residual nickel was <0.10 mg/L at an iron:nickel ratio of 1 or greater, regardless of the C sub T concentration. The best overall nickel removal at pH 9 was obtained at an iron:nickel ratio of 1.0 and a C sub T of 50 mg/L where the total and soluble residual nickel concentrations were 0.20 mg/L and 0.10 mg/L, respectively. Nickel removals from the actual wastewater were similar in that pH 10 was a better process pH than pH 9. At pH 9, the most efficient nickel removal for the actual wastewater occurred at an iron:nickel ratio of 2.0 and a C sub T of 0. This produced total and soluble residual nickel concentrations of 0.30 mg/L and 0.25 mg/L. The use of the anionic and cationic polymers did not enhance nickel removal appreciably. The multi-regression analyses produced fair replication of the data. However, in some instances the correlation was low. Before a model such as the one developed here is used to determine operating conditions, additional data should be collected to verify the model validity. The economic analysis showed that the best overall treatment scheme to meet permit requirements for the actual wastewater was lime addition to pH 10. The associated treatment cost was $53.49 per 100,000 gallons. All other treatment schemes involved addition of iron or soda ash at an overall treatment cost greater than $53.49 per 100,000 gallons. (See also W88-02132) (Lantz-PTT)
W88-02174

REMOVAL OF CADMIUM AT HIGH AND LOW DOSAGES BY AN EXTENDED AERATION PROCESS,

Delaware Univ., Newark. Dept. of Civil Engineering.
W. L. Lowe, and A. F. Gaudy.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 431-442, 9 fig, 1 tab, 26 ref.

Descriptors: *Cadmium, *Aeration, *Metal-finishing wastes, *Wastewater treatment, Biological treatment, Biomass, Heavy metals, Solids.

An extended aeration biomass can retain extremely high concentrations of cadmium, in this study in excess of 2,000 mg/L, without ill effects on the biochemical efficiency of wastewater purification. It is thus concluded that biological processes offer a viable alternative for removal of heavy metals from wastes containing rather high concentrations of such metals, and it is recommended that work on other heavy metals and on mixtures of heavy metals using biological processes is warranted. In cases where the waste contains too little organic matter to synthesize biomass, it would be necessary to add organic material. However, the hydrolytic assist, which can be caused to recover the heavy metal from the sludge, also makes it possible to recirculate the organic matter. Within the range of operational conditions utilized in these studies, it does not appear that the biological process can be operated without some breakthrough of soluble cadmium in the effluent, and even addition of a second 'polishing' reactor did not clear up all traces of soluble cadmium. A problem encountered in biological treatment of wastes containing heavy metals, in addition to incomplete removal of the metal, is increased loss of biological solids in the effluent. This may necessitate the use of polymers or other modifications to the process to accomplish solids reduction before discharge. Definite conclusions regarding the mechanism of protection of the biomass from the toxic effects of the heavy metal cannot be made, but it would appear that long-term exposure to cadmium does select for a biomass which exhibits tolerance of rather high concentrations of the metal. Cadmium was present primarily in colloidal form, and make tenable the argument that it must be entrapped in capsular

and/or slime materials exterior to the cytoplasm. Since cadmium escaping the system, except at the very high loadings applied during the last days of the experimentation, was not associated with biological solids, it is attractive to speculate that the same factor may be involved in both failure to flocculate and failure to adsorb cadmium. (See also W88-02132) (Lantz-PTT)
W88-02175

EVALUATION OF VERMICULITE, IRON FILINGS, LIME, SULFIDE, AND LIME SULFIDE IN THE TREATMENT OF PLATING RINSEWATERS,
Tennessee Technological Univ., Cookeville. Dept. of Civil Engineering.
T. N. Eisenberg, W. P. Bonner, N. S. R. Chuang, and K. M. Guss.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 443-450.

Descriptors: *Vermiculite, *Iron filings, *Lime, *Sulfides, *Lime sulfide, *Wastewater treatment, Metal-finishing wastes, Performance evaluation, Chromium, Copper, Nickel, Zinc, Heavy metals, Cost analysis, Hydrogen ion concentration, Clarification.

The purpose of this investigation was to compare the effectiveness of several treatment methods for the removal of Cr, Cu, Zn, and Ni from the discharges of a small plating company. The company is located in one of the more rugged areas of Middle Tennessee and is believed to be the source of Cr and Cu which were found in water taken from a nearby well. Five treatment alternatives were investigated, two physical (iron filings adsorption and vermiculite ion exchange) and three chemical (lime precipitation, sodium sulfide precipitation, and sodium sulfide-lime precipitation). The objective was to minimize cost, to simplify operation, and to meet effluent guidelines. All five treatment methods investigated were capable of meeting effluent criteria. Iron filings adsorption was eliminated due to high transportation costs and earthquake availability. Vermiculite was eliminated due to the unavailability of the natural unexpanded form to determine design criteria. Of the remaining three chemical precipitation methods, lime precipitation was selected on the basis of cost and simplicity. Further testing was conducted to determine the effect of pH on metal removals by lime precipitation. Since metal removal efficiencies were essentially the same over a pH range from 9.0 to 10.5, it was decided to raise the pH to 9.0 and discharge the supernatant after settling with no pH adjustment. The Cr-Zn and Ni-Cu rinsewaters are collected in separate tanks. Prior to mixing the two rinsewaters, 288 mg/L (12 lb/5000 gal) $NaHSO_3$ is added to the CR-Zn rinsewater is rapidly mixed for 30 minutes to reduce Cr(6+) to Cr(3+). The reduced Cr-Zn rinsewater and the Ni-Cu rinsewater are then fed to the clarifier. A 10% lime slurry is added to the 1:1 mixture until the pH value reaches 9.0 (120 lb/10,000 gal). The 10,000 gallon mixture of rinsewaters is then rapid mixed for 30 seconds, slow mixed for 30 minutes, and allowed to settle overnight. The clarified supernatant is discharged to the receiving stream and the settled floc is gravity fed to the sludge thickener. (See also W88-02132) (Lantz-PTT)
W88-02176

ADSORPTION OF HEAVY METALS WITH INERT BIOLOGICAL SLUDGES AT NEUTRAL PH'S,
Puerto Rico Univ., Mayaguez. Dept. of Civil Engineering.
R. A. Roman-Seda.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 451-458, 11 fig, 3 tab, 10 ref. Dept. of the Interior Grant No. 14-34-0001-2141.

Descriptors: *Heavy metals, *Adsorption, *Sludge, *Hydrogen ion concentration, *Wastewater treatment, Cadmium, Nickel, Lead, Chromium, Chemical analysis, Sludge utilization.

An attempt was made to ascertain what ordinary secondary sludges can do to remove dissolved heavy metals from wastewaters at neutral pHs. The objectives of this study were: (1) to determine whether there exists in biological sludges a significant biosorption capacity for the removal of cadmium, lead, nickel, and chromium; and (2) to determine the effects of the operational parameters of contact time, sludge concentration, and initial metal concentration on overall removal. The dry sludge was sifted to remove sand and other foreign matter and then hand ground and passed through a sieve with 425 mm openings to insure uniform size particles. Solutions of the desired metal were prepared by dissolving exact quantities of atomic absorption grade metal standard in redistilled deionized water to obtain the desired metal concentrations. Solution pH was adjusted as needed. A series of isotherm experiments were performed utilizing a constant temperature water bath equipped with a shaker with capacity for 24 Erlenmeyer flasks. Maximum or near maximum removals are obtained for cadmium, nickel and lead at the neutral pH region, while maximum removal for chromium is obtained at pH 4.5 to 5.5. Cadmium and lead can be reduced to levels close to the water quality standards, and nickel was reduced to 60% of its original amount. Optimum contact time seems to lie between 2 and 4 hours for the metals tested. Optimum sludge concentrations show a spread between 2 to 8%. The remaining fraction seems to remain constant with increasing initial metal concentrations over the ranges tested. Conventional adsorption models do not fit the data adequately; adsorption may be caused by electrical interactions rather than by physical adsorption. The adsorptive capacity of the sludge was found to be very high. (See also W88-02132) (Lantz-PTT)
W88-02177

PERFORMANCE OF BUOYANT MEDIA FILTER IN METAL PLATING SHOP WASTEWATER TREATMENT,
Minnesota Mining and Mfg. Co., St. Paul.
J. S. Hunter.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 459-465, 2 fig, 3 tab, 1 ref.

Descriptors: *Buoyant media filter, *Metal-finishing wastes, *Wastewater treatment, Performance evaluation, Filtration, Electroplating, Suspended solids, Chemical precipitation, Clarification, Heavy metals.

A little known technology called buoyant media filtration has been found to provide some unique benefits to the electroplating/metal finishing industry when used in conjunction with conventional metal hydroxide precipitation wastewater treatment. Because of their ability to accomodate very high influent suspended solids concentrations, buoyant media filters can be used to replace conventional clarifiers and filters operated in series. When the buoyant media filter is used in the more conservative application of polishing clarifier effluent, it will continue to function even when a severe upset is occurring in the upstream clarifier that would preclude operation of a conventional sand filter. Additional advantages include a low operating headloss (2 to 4 in of water) that permits gravity flow operation and a built-in backwash holding tank that further reduces capital costs and space requirements. The purpose of this paper is to report on a field study of a full-scale buoyant media filter used as a part of an actual metal hydroxide precipitation wastewater treatment system at a plating shop. In comparative tests it was found that when used as a replacement for a clarifier, this buoyant media filter produced an effluent of better quality than that of a slant tube clarifier which is the current electroplating/metal finishing industry standard for solids removal in a metal hydroxide wastewater treatment system. When the buoyant media filter was used to polish slant tube clarifier effluent, it was found that the filter provided no additional removal of metals or suspended solids as long as the clarifier was functioning properly. When the clarifier entered into a severe upset condition, the filter was able to accommodate high concentrations of influent suspended solids and still produced the same quality effluent as when the clarifier was operating properly. This is a definite advantage over conventional sand filters because it allows continued plant operation in circumstances that now either require shutdown or the discharge of an effluent that does not comply with effluent limitations. (See also W88-02132) (Lantz-PTT)
W88-02178

REVERSE OSMOSIS MEMBRANE FOULING BY SANITARY LANDFILL LEACHATE AND COPPER PLATING SOLUTIONS,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
R. N. Kinman, J. W. Stamm, and D. Nutini.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 467-475, 9 fig, 9 tab, 13 ref.

Descriptors: *Wastewater treatment, *Reverse osmosis, *Membrane fouling, *Sanitary landfills, *Metal-finishing wastes, *Copper, Membrane processes, Silt density index, Permanganates, Chemical analysis.

Reverse osmosis is a pressure driven membrane separation process which may be used for desalination of water, water reclamation from various pollutional sources, concentration of metals from dilute waste streams. Relationships between specific ions or compounds in the water and fouling of the membrane have not been fully explained. Currently, the results of a simple filtration test, the Silt Density Index (S.D.I.) and more recently the permanganate demand test have been used to determine if the process can be reasonably operated for an extended period of time without fouling. This work was conducted for: (1) further evaluation of the permanganate demand test and the silt density index was carried out on two industrial waste streams; (2) to attempt to determine linear relationships between S.D.I. and the permanganate demand test (PDI) and fouling by the two wastes, and (3) to develop an equation which would predict where a membrane has fouled beyond its useful operation (minimum flux) for these two wastes. S.D.I. tests indicated the electroless copper plating waste would foul the membrane; however, the R.O. treated the waste effectively for the six month period of the project. No definable relationship between fouling and the S.D.I. was established for this waste stream. Permanganate demand provided a qualitative standard for this waste stream but failed to provide a strong linear relationships to flux decline for the electroless copper plating waste stream. (See also W88-02132) (Lantz-PTT)
W88-02179

SODIUM BOROHYDRIDE REDUCES HAZARDOUS WASTE,
Morton Thiokol, Inc., Danver, MA. Ventron Div.
M. J. Lindsay, M. E. Hackman, and R. J. Tremblay.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 477-482, 2 fig, 1 tab, 4 ref.

Descriptors: *Sodium borohydride, *Hazardous wastes, *Wastewater treatment, *Water quality control, Sludge, Clarification, Suspended solids, Filtration, Iron, Sulfates, Filtration, Cost analysis, Sludge disposal, Copper, Waste disposal.

Sludge reduction was a major goal at the Ventron Division of Morton Thiokol, Inc. facility. The clarifier could not accomodate the solids loading from the $FeSO_4$ system resulting in costly, continuous operation at the filter press. With essentially no additional capital costs, the VenMet system (a stabilized caustic solution of sodium borohydride) was successfully implemented providing effluent copper levels typically less than 1 mg/L. The sludge from the chelated wastes was reduced 82%, and the filter cake dewatered to 55% TS average as compared to 35% TS average with ferrous sulfate. The operation of the filter press was re-

duced from continuous operation to approximately three times per week and cycle times were cut in half. As a result of the sludge reduction, sludge disposal costs for the chelated wastes decreased 82% and overall daily operating costs (both chelated and non-chelated) were reduced 12%. Further optimization of the VenMet system is expected to yield lower chemical costs. In addition to the above benefits, the copper content of the sludge from the chelated wastes increased from approximately 5% to 80% (on a dry weight basis) rendering the sludge suitable for reclamation and thus reducing, and possibly eliminating, the liability associated with hazardous waste disposal. Once the VenMet system is fully optimized in the chelated waste treatment line, this manufacture plans to implement VenMet solution on the non-chelated waste line. This is expected to yield a similar reduction in sludge volume and further reduce sludge disposal costs. (See also W88-02132) (Lantz-PTT)
W88-02180

ENGINEERING AND DESIGN OF A WASTEWATER TREATMENT SYSTEM FOR A VIBROBOT PLATING OPERATION,
Ramirez Associates, Far Hills, NJ.
E. R. Ramirez, and J. P. Van Dillen.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 483-491, 5 fig, 3 tab, 7 ref.

Descriptors: *Wastewater treatment, *Vibrobot, *Metal-finishing wastes, *Water pollution control, Electroplating, Cost analysis, Metals, Rinsing, Salts.

Wastewater treatment needs and requirements of small metal plating operations whose wastewater volume falls between 3,000 to 10,000 gpd are analyzed. These manufacturing centers most often are involved in plating precious metals on small micro parts varying from complex jewelry to electronic components whose dimensions are measured in tenths of an inch. The parts are irregular, often threaded, possessing blind holes and varying sized cavities. These parts often nest and occasionally undergo excessive mechanical distortion problems when processed by conventional barrel plating units. Vibrobot electroplating handles components and parts in bulk very much as does barrel plating. Depending on the size of the Vibrobot unit, typical metal plating loads will vary from 6 pounds to 22 pounds to 33 pounds. These parts are vibrated in a spiral forward and upward motion during the plating and metal finishing operation. On completing 360 degrees, the raised and vibrated parts precipitously dropped (about 3 in) to their original elevation. This process continues until the desired electroplated metal thickness is achieved. In the operation, air bubbles are removed from blind holes and are statistically exposed to electrodepositing currents. Vibrobot electroplating technology reduces wastewater generation by approximately 50% as compared to conventional barrel plating and therefore simplifies wastewater treatment. Because the Vibrobot System produces less wastewater per 100 sq ft of plated surfaces, it allows platers to stay below the 'magic' 10,000 gpd figure. Drag-out concentrate from a Vibrobot plating tank is approximately 25% less than from barrel plating. This is because the parts are shaken dry. The cost of wastewater treatment for a Vibrobot operation is far less expensive than that of barrel plating. It was projected that Vibrobot plating operations need one-half the capital required as compared to a corresponding barrel plating facility. (See also W88-02132) (Lantz-PTT)
W88-02181

STUDIES OF THE UPTAKE OF HEAVY METALS BY ACTIVATED SLUDGE,
Metropolitan Sanitary District of Greater Chicago, IL. Dept. of Research and Development.
G. Elenbogen, B. Sawyer, C. Lue-Hing, K. C. Rao, and D. R. Zenz.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 493-505, 3 fig, 6 tab, 15 ref.

Descriptors: *Heavy metals, *Activated sludge, *Adsorption, *Wastewater treatment, *Chicago, *Illinois, Aeration, Suspended solids, Pilot plants, Cadmium.

The Metropolitan Sanitary District of Chicago (District) examined reducing sludge metal concentrations by operational changes to the wastewater treatment process. In order to determine the feasibility of utilizing solids retention time (SRT) as a means of metals control at District facilities, a series of pilot plant and laboratory studies were conducted to study the relationship between SRT and metals uptake by activated sludge. In the pilot plant studies, two 60-gallon (227 L) aeration-capacity activated sludge pilot plants were operated simultaneously under identical conditions, except for SRT and the resultant mixed liquor suspended solids (MLSS) concentrations. One pilot unit was operated at a three-day SRT and one at a ten-day SRT in order to determine whether mixed liquor metals concentrations, on a dry weight basis, were affected by the SRT of the system. The following conclusions were made: (1) Cadmium adsorption on MLSS is virtually instantaneous with greater than 90% of influent cadmium being adsorbed within a few minutes of contact and up to 97 to 98% adsorption occurring within normal operation aeration periods; (2) the control of SRT in the activated sludge process cannot be used as an operational technique for controlling mixed liquor metal concentrations at the West-Southwest STW; (3) mass balance procedures cannot compete with direct measurement procedures in determining the effects of SRT, or in discriminating between the effects of SRT and other potential influences on metals uptake by activated sludge; (4) the batch aeration experiments indicate that at MLSS to Cd ratios greater than 1,000:1 almost instantaneous adsorption of soluble Cd by mixed liquor solids occurs at initial Cd concentrations of up to 10 mg/L; and (5) in addition, it appears that even with the high adsorptive capacity of mixed liquor solids at the West-Southwest STW, influent soluble Cd concentrations greater than 2.0 mg/L, at MLSS:Cd ratios of less than 500:1, could possible cause effluent Cd concentrations to exceed 0.15 mg/L, which is the current effluent limit for the West-Southwest STW. (See also W88-02132) (Lantz-PTT)
W88-02182

NITRIFICATION IN REFINERY WASTEWATER TREATMENT,
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
J. A. Mueller, K.-B. Wu, and S. Kaczmarek.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 507-522, 14 fig, 11 tab, 17 ref.

Descriptors: *Nitrification, *Wastewater treatment, *Oil refineries, *Biological treatment, Oil industry, Ammonia, Solids, Nitrates, Biomass, Hydraulic retention time, Solids retention time, Phenols, Hydrogen ion concentration, Dissolved oxygen, Temperature.

Five bench scale activated sludge units were operated to compare nitrification activities under steady-state and transient loading conditions. The reactors were operated with target SRTs of 20 and 50 days, and HRTs of 6 and 12 hours. This range covers typical conditions in refinery treatment plants. In addition, 2 reactors received normal feed supplements. During steady state conditions, a high degree of nitrification, 80% TKN removal and 99% ammonia removal, was measured in all reactors treating refinery wastewater, independent of their solids retention time (20-50 days) and hydraulic detention time (from 6-12 hours). An ammonia transient load of 100 mg/L over a 4 hour period caused temporary increases in both effluent ammonia and nitrite concentrations from all reactors. Neither the 100 mg/L ammonia nitrogen transient, the 50 mg/L MEA nitrogen transient, nor the 50 mg/L MDEA nitrogen transient exhibited toxic or inhibitory impacts on the reactors. Rather, increased ammonia and nitrite concentrations were due to the inability of the organisms in the reactor to rapidly respond to the transient load. The most active and highly loaded reactor provided the highest removals of the nitrogen transient loads. A phenol transient of 100 mg/L over a 4 hour period caused marked inhibition of nitrification. Once the phenol was degraded, nitrification rapidly resumed. Though ammonia levels stabilized quickly, nitrite removal required greater than a 24 hour period to return to prior steady state levels. Powdered activated carbon and long hydraulic residence times generally provided the more stable nitrification performances, both during steady state and transient loading periods. By maintaining proper operating conditions of pH, DO, temperature, and SRT, the activated sludge reactors in this study showed an ability to accept shock loads typically encountered in refinery treatment plants with no more than a temporary impact on nitrification. (See also W88-02132) (Lantz-PTT)
W88-02183

PRETREATMENT THROUGH CHEMICAL OXIDATION. GENERAL CONSIDERATIONS AND A CASE STUDY INVOLVING A THIOSULFATE/SULFIDE LADEN WASTESTREAM,
Interox America, Houston, TX.
J. R. Walton, J. A. Rutz, and S. B. Magid.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 523-527, 4 fig, 3 tab, 7 ref.

Descriptors: *Pretreatment of wastewater, *Chemical oxidation, *Case studies, *Thiosulfates, *Sulfides, Phenols, Dissolved oxygen, Biological oxygen demand, Chemical oxygen demand, Pollution load, Oil refineries, Industrial wastewater.

Chemical oxidation is most appropriate for those wastes containing oxidizable toxics (phenol and sulfide) or substances which adversely affect subsequent processes through dissolved oxygen scavenging (sulfide, sulfite, and thiosulfate), or in certain cases general waste overloads (BOD, COD). One must be careful with the particular oxidant system chosen so as to minimize wasteful side reactions or over-oxidations, toxic by-product formation, and/or residual oxidant carry-over into downstream processes. In general, chemical oxidation is more appropriate for: (1) relatively low flow, concentrated wastestreams; (2) highly variable waste loads of moderate flow; (3) wastestreams of such a nature to cause biosystem strain or upset; and/or (4) wastestream which contribute to unacceptable corrosion or odors. In assessing the feasibility of oxidative pretreatment, it is important to evaluate both composite and grab samples so that both relative pollutant loads and variations thereof are considered. This paper outlines the considerations involved in instituting an oxidative pretreatment program using, as an example, the application of hydrogen peroxide to destroy thiosulfate and sulfide in a petroleum refining wastestream. (See also W88-02132) (Lantz-PTT)
W88-02184

PROCESS CONSIDERATIONS IN LAND TREATMENT OF REFINERY SLUDGES,
Post, Buckley, Schuh and Jernigan, Inc., West Palm Beach, FL. Solid and Hazardous Waste Div.
T. G. Sprehe, L. E. Streebin, J. M. Robertson, and P. T. Bowen.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 529-533, 8 ref.

Descriptors: *Wastewater treatment, *Land disposal, *Oil refineries, *Sludge, Oil industry, Volatile organics, Hydrocarbons, Model studies, Pollution load, Temperature, Soil water, Humidity, Organic compounds, Chemical analysis.

As part of the EPA's Hazardous Waste Land Treatment Research Program, an extensive field project was undertaken at the University of Oklahoma to evaluate and optimize physical, chemical, biological, and operational factors which control the process of land treatment of oil sludge. The purpose of the research was to study the land treatment of API separator sludge in order to establish operational guidelines and a rational basis

for process design. It was recognized that the usefulness of such guidelines would be less in their application to situations closely matching the conditions of the subject study than as a general approach to a variety of oily waste types and site conditions. Specific objectives were to determine optimum sludge loading rates and application frequencies, as well as to identify operational considerations important to the process. Additional research objectives were to study the fate of selected priority pollutants commonly present in oily sludges, and to assess the volatile atmospheric emissions from their application to land. In assessing volatile emissions from land treatment, the objectives were to: (1) determine the rate and magnitude of fugitive hydrocarbon emissions; (2) evaluate and model the effects of parameters such as sludge loading rate, temperature, soil moisture, and relative humidity on the quantity of emissions; and (3) identify and quantify individual compounds being emitted. Volatile emissions were thus accounted for in the oil mass balance equation. The study recommended that comprehensive waste characterization, soil testing, and pilot treatability studies be conducted prior to design and construction of an oily waste land treatment system. Testing the mechanical properties of potential site soils both before and after oily sludge addition in the laboratory is critical in order to estimate important characteristics of the soil during system operation. (See also W88-02132) (Lantz-PTT)
W88-02185

TOWER-BIOLOGY (R) AND ITS APPLICATION FOR THE NITRIFICATION/DENITRIFICATION OF AMMONIA-RICH WASTEWATER,
Bayer A.G., Leverkusen (Germany, F.R.).
G. Diesterweg, I. Pascik, and J. F. Lawson.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 535-542, 5 fig, 3 tab.

Descriptors: *Wastewater treatment, *Nitrification, *Denitrification, *Ammonia, *West Germany, Tower-Biology, Aeration, Flocculation, Degassing, Separation techniques, Sedimentation, Odors.

The elimination of nitrogen from wastewater effluents is becoming increasingly important in the Federal Republic of Germany. Conventional biological wastewater treatment plants have aeration basins with a water depth between 2.5 m (8 ft) and 8.0 m (26 ft). Bayer AG has developed a process where the water level in the aeration tank is usually between 8 m (26 ft) and 25 m (82 ft). This great depth of water is the reason for naming the process 'Bayer Tower-Biology'. This is a two-phase injector which utilizes the kinetic energy of the water jet to efficiently disperse the air flow into extremely fine bubbles. A Tower-Biology system has four major process stages: (1) separation of course material in order to protect the injectors. The slot-shaped injector has a minimum opening size of 16 mm (0.62 in); (2) the aeration tower; (3) the degassing and flocculating cyclone are located downstream of the aeration tank. This unit is optimized for the volumes of wastewater to be treated. It degasses the water by rotary flow and increases the size of the activated sludge floc by flocculation and thus improving the sedimentation in the final clarification system; and (4) Vertical-flow sedimentation tanks of the Dortmund tank type are mainly used for the final clarification. This type of final clarifier is used not only because of its excellent clarification properties, the absence of moving parts in the tank, and the formation of a suspended filter bed, but also because Dortmund tanks can be constructed in elevated concrete columns thus minimizing the pumping energy required to transfer the activated sludge back from the final clarification system to the aeration tower. The advantages of Tower-Biology in comparison with conventional processes are: (1) the small amount of space required; (2) the greater efficiency of the aeration equipment; (3) the lesser degree of unpleasant smells; and (4) the reduced noise level. (See also W88-02132) (Lantz-PTT)
W88-02186

INSTITUTIONAL BARRIERS TO LAND TREATMENT OF METAL FINISHING WASTEWATERS,
North Central, Inc., Palatine, IL.
F. J. Blaha, G. L. Taylor, and R. O. Ball.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 543-549, 5 fig, 8 tab, 6 ref.

Descriptors: *Wastewater treatment, *Land disposal, *Metal-finishing wastes, Heavy metals, Organic compounds, Economic aspects, Design standards, Groundwater pollution.

Metal finishing wastewaters are produced from a number of processes and typically have significant quantities of heavy metals and organic contamination. The organic contamination originates from the oils and greases used for corrosion inhibition or lubrication during processing operations. The heavy metals originate from etching the process stock, from plating/treatment baths, or from corrosion protection systems. These wastewaters are typically pretreated and discharged to a Public Owned Treatment Works; less frequently these wastewaters are discharged in accordance with an NPDES permit. The pretreated wastewater is in many cases suitable for land treatment. The benefits to be gained from land treatment include: low capital investments for equipment, small land requirements, no NPDES or categorical standards, ultimate disposal of the wastewater, and the ability to locate manufacturing plants in areas without existing sewers or suitable waterways for effluent discharge. Clearly, land treatment can be a major component in a cost-effective management system for metal finishing wastewaters. Despite the advantages enumerated above, and the widespread application of land treatment systems to other wastewaters, a number of institutional barriers exist that may discourage the use of this technology. These institutional barriers include: (1) limited number of operating systems treating metal finishing wastewaters; (2) lack of standardized design methodologies (e.g. state design manuals); (3) inaccuracies in standard references; (4) different characteristics of municipal wastewaters and pretreated metal finishing wastewaters; (5) resistance to the application of technology transfer; and (6) concern for the potential groundwater effects. A general discussion of these obstacles is presented with a case study of how these obstacles were overcome for a plant in the coil coating category. (See also W88-02132) (Lantz-PTT)
W88-02187

METALS RECOVERY FROM WASTE ACIDS,
Recycle Metals, Glastonbury, CT.
C. S. Brooks.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 551-559, 9 tab, 13 ref.

Descriptors: *Heavy metals, *Separation techniques, *Wastewater treatment, *Metal-finishing wastes, *Waste acids, Nickel, Copper, Zinc, Solvent extraction, Lauric acid, Sodium lauryl sulfate, Iron, Chromium, Cation exchange, Flocculation.

Bench scale evaluation tests of the feasibility of achieving promising separation of metals, such as Ni, Cu, and Zn, in the presence of Cr and Fe from industrial waste pickling acids have been conducted. Precipitation, solvent extraction, cation exchange and flotation separation technologies were evaluated. The separation concept which was evaluated consisted of adjusting the pH of the waste acids with alkalis to a moderately acid range of 2 to 5 to precipitate the bulk of the Fe, followed by the separation of the Ni, Cu and Zn, using solvent extraction with lauric acid/xylene, cation exchange with a hydrogen resin and precipitate flotation with lauric acid and sodium lauryl sulfate. All three separation alternatives were found to provide promising recovery (>67%), dependent upon the waste acid composition. New England metal finishing industry waste acids commonly contain numerous components other than Ni, Cu, Zn, Cr and Fe, such as alumina and silica, and metals such as Cd, Co, Ti, Sn, Mo, W, Nb, Ta, Zr, etc., plus certain organic surfactants, all of which complicates any separation scheme devised. The emphasis in the present study has been focused on separation of Ni, Cu and Zn from Fe and Cr. A principal conclusion of this study is that each waste system is a special case that requires evaluation and selection of the several modes most appropriate for recovery of metals of interest. For example, employing only the procedures evaluated here: (1) for the mixed pickling acid, solvent extraction could be used for selective separation of the bulk of the Cu and precipitate flotation with lauric acid and sodium lauryl sulfate for recovery of Ni and Zn; and (2) for the chromic pickling acid, cation exchange could be used for separation of the bulk of the Cu and Zn, followed by either solvent extraction or flotation of the Ni. (See also W88-02132) (Lantz-PTT)
W88-02188

EVALUATION OF INDUSTRIAL PROCESS MODIFICATIONS TO REDUCE HAZARDOUS WASTES IN THE ARMED SERVICES,
CH2M/Hill, Reston, VA.
T. E. Higgins, R. B. Fergus, and D. P. Desher.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 581-588. DOA Contract No. DAC A87-84-C-0076.

Descriptors: *Water quality control, *Process control, *Hazardous wastes, *Wastewater treatment, *Department of Defense, Recycling, Waste recovery, Industrial wastewater, Metal-finishing wastes, Paints, Solvents.

Since 1980 it has been Department of Defense (DOD) policy to limit the generation of hazardous waste through alternative procurement policies and operational procedures that are both environmentally attractive and economically competitive. The Army, Navy, Air Force were directed by DOD to reduce quantities of hazardous waste, when feasible, through resource recover and reclamation, recycling, source separation, and raw material conservation. In carrying out the intent of these policies, many studies have been performed that recommended industrial process modifications which, if successful, had the potential to significantly reduce the generation of hazardous wastes at the source, rather than require treatment at end-of-pipe facilities. Several have been successfully implemented, and many others either were not implemented or failed to meet their goals. DOD operates industrial facilities to repair and recondition planes, helicopters, ships, tanks, and other vehicles and equipment. Metal finishing operations, which are performed at over 100 DOD industrial facilities, produce most of DOD's hazardous wastes. Metal finishing operations include: paint stripping, solvent cleaning (i.e., removal of dirt, oils, grease, and corrosion products), metal plating, and painting. This paper examines process modification case studies from each of these four metal finishing categories. (See also W88-02132) (Lantz-PTT)
W88-02191

MICROBIAL DEGRADATION OF HAZARDOUS WASTES BY LAND TREATMENT,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
D. F. Kincannon, and Y. S. Lin.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 607-619, 10 fig, 9 tab. EPA Contract No. CR 81025 01-0.

Descriptors: *Biodegradation, *Land disposal, *Hazardous wastes, *Wastewater treatment, Organic compounds, Organic carbon, Industrial wastes, Dinitrophenol, Trichlorophenol, Dimethylphenol, Chloronaphthalene, Chemical equations, Soil types, Temperature, Soil moisture.

High treatment efficiencies (in terms of TOC and specific chemicals) can be achieved by biodegradation of industrial sludges in land treatment systems.

This study shows that waste sludges containing toxic or hazardous chemicals can be accommodated in land treatment systems. When treatment efficiency was based upon the removal of specific priority pollutants (dinitrophenol, trichlorophenol, dimethylphenol and chloronaphthalene), it was found that the priority pollutants were removed to very low levels. It was found that the removal of the organic pollutants could not be described by simple kinetic equations, but that the removal could be described by one, two, or in some cases, three first order rates. It was also found that the first order rates were a function of loading, type of waste, type of soil, temperature, moisture content, and cultivation. Some of the specific chemicals were removed by stripping as well as by biodegradation. No evidence of downward migration of pollutants was observed in this study. This may have been the result of careful control of the moisture content of the columns. Water was never added in excess. (See also W88-02132) (Lantz-PTT)
W88-02193

EFFECTS OF ALKALINITY AND HARDNESS ON ANAEROBIC DIGESTION OF LANDFILL LEACHATE,
Black and Veatch, Kansas City, MO.
J. L. Carter, P. E. Schafer, R. T. Janeshek, and G. C. Woelfel.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 621-630, 1 fig, 9 tab, 3 ref.

Descriptors: *Alkalinity, *Hardness, *Wastewater treatment, *Landfills, *Anaerobic digestion, *Leachates, Calcium, Magnesium, Iron, Zinc, Biological oxygen demand, Bicarbonates, Sludge, Chemical oxygen demand, Phosphorus, Metals.

Landfill leachate contains primarily neutralized volatile acids which are readily treated anaerobically. The neutralized salts in the Omega Hills landfill were predominantly calcium, magnesium, iron, zinc. The anaerobic treatment system slowly built up an active mass capable of better than 93% BOD removal. Startup data verified that volatile acid at concentrations 8,000 mg/L or less are not toxic to the anaerobic bacteria as long as the pH is maintained in a suitable range. Insufficient phosphorus concentrations caused a loss of solids and limited the rate of accumulation of active microbial mass required for stabilization of the leachate. Alkalinity in the leachate was due to salts of the volatile acids, not the normal bicarbonate alkalinity found in industrial wastes. The metabolism of the salts of the volatile acids produced methane and carbon dioxide and released cations from the volatile acid salts. The carbon dioxide reacted with the released cations to form bicarbonate alkalinity. Because of the reactor's high pH and temperature, inorganic metals precipitated. Sludge wasting must be adequate to remove the precipitated solids and prevent the media from becoming clogged. On the other hand, it is important that the wasting rate not be excessive, or the active biomass in the reactor can become too low for efficient BOD removal. The treatment system operated in a very stable manner and was able to remove 17 g/d of COD per liter of media with a 3.8 day hydraulic retention time. The importance of sludge wasting and addition of sufficient phosphorus was shown. Finally, the pilot plant study confirmed the suitability of anaerobic treatment for leachate and made it possible to reduce the media volume used in the full-scale system. (See also W88-02132) (Lantz-PTT)
W88-02194

INFLUENCE OF INDUSTRIAL WASTES ON THE FORMATION OF VOLATILE HALOGENATED ORGANICS DURING EFFLUENT CHLORINATION,
Cook Coll., New Brunswick, NJ.
J. V. Hunter, M. M. Busby, and H. Chang.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 631-638, 8 tab, 4 ref.

Descriptors: *Wastewater treatment, *Water pollution sources, *Volatile halogenated organic compounds, *Chlorination, Industrial wastewater, Sludge, Metals, Organic compounds, New Jersey.

In an industrialized state such as New Jersey, most large wastewater plants contain significant proportions of industrial wastes, many of which are organic in nature. The question arose as to what influence these wastes would have on the production of halogenated organics during effluent chlorination. The increased complexity due to the additional industrial organics could be significant if these organics act as precursors for halogenated organics. The purpose of the research described in this paper was to determine the nature and the extent of this effect. Four Northern New Jersey plants were selected for this study. The plants contained approximately 0%, 23%, 27% and 50% industrial wastewaters by volume. All were secondary treatment plants (activated sludge or one of its modifications) employing effluent chlorination. Grab samples were obtained at the point of the discharge from the secondary clarifier and from the points of discharge from the chlorination tanks. High concentrations of volatile halogenated organics in the influent of the chlorination tanks observed for those wastewaters containing industrial wastes made these observations of the formation of volatile halogenated organics very difficult. It can only be stated that there may be a positive correlation between degree of industrialization and haloform formation. This does not imply that there was not effect. There was an excellent correlation between halogenated organics in a chlorinated effluent and the external industrial wastes contents of the initial wastewater. This correlation, however, is mainly due to the fact that the halogenated organics are in the influent to the chlorination tanks, not because they were formed during chlorination. (See also W88-02132) (Lantz-PTT)
W88-02195

TOXIC POLLUTANT REMOVALS AND REMOVAL CREDITS AT A MAJOR POTW,
Los Angeles County Sanitation Districts, Whittier, CA.
S. R. Austin, P. C. Martyn, J. G. Kremer, and R. P. Miele.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 639-647, 5 fig, 5 tab.

Descriptors: *Wastewater treatment, *Publicly owned treatment works, *Removal credits, *California, *Los Angeles, Hazardous wastes, Economic aspects, Waste disposal, Toxicity, Pretreatment of wastewater, Costs, Industrial wastes, Wastewater facilities.

Removal credits to companies that discharge to public sewers are an essential part of the EPA's program to establish equivalent wastewater disposal burdens on direct and indirect dischargers as mandated by the Clean Water Act. Basing the removal credits on the performance of individual public operated treatment works (POTWs), however, does not fully establish this equivalency. Since pollutants are easier to remove from concentrated wastestreams than from more dilute wastestreams, industrial users of POTWs with high toxic pollutant loadings will have higher revised pretreatment standards and lower costs than users of less industrialized systems. Also, a program that is not implemented does not exist. If the EPA does not grant POTWs the authority to grant removal credits, the removal credits will be of no benefit to industrial dischargers. The Sanitation Districts of Los Angeles County's experience indicates that administering removal credits may be more complicated than had been anticipated. As an industrial wastewater pretreatment program goes into effect, the POTW influent concentrations of toxic pollutants will decrease. This may or may not cause the actual removal rates to decrease, but, as the influent concentrations approach the detection limit, the measured removal rates, which are used to determine removal credits, will drop dramatically. The Sanitation District's data also indicate that a single year;s data may not adequately characterize the long-term performance of a wastewater treatment plant. Normal fluctuations in influent concentrations, treatment plant performance and other factors will cause fluctuations in the removal rates. This means that several years and several downward adjustments in the removal credits may be required to establish the removal credits at a level that the treatment plant can consistently meet. (See also W88-02132) (Lantz-PTT)
W88-02196

ILLEGAL LIQUID INDUSTRIAL WASTE SITE CLEAN-UP AND RESTORATION,
Ontario Ministry of the Environment, Toronto (Ontario). Environmental Approvals and Project Engineering Branch.
For primary bibliographic entry see Field 5G.
W88-02197

CONTINUOUS FIXATION AND REMOVAL OF EXPLOSIVE WASTES FROM PINK WATER USING SURFACTANT TECHNOLOGY,
Army Armament Research and Development Command, Watervliet, NY. Large Caliber Weapon Systems Lab.
D. J. Freeman.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 659-676, 4 fig, 16 tab, 7 ref.

Descriptors: *Continuous fixation, *Wastewater treatment, *Explosives, *Pink water, *Surfactants, *Water quality control, *Chemical treatment, Trinitrotoluene, Water pollution prevention, Hydrogen ion concentration, Chemical reactions, Triazines, Dinitrobenzene, Tetrazines, Chemical precipitation.

A continuous-flow two-stage reactor surfactant treatment process can be used to remove virtually 100% of both TNT (trinitrotoluene) and RDX (hexahydro-1,3,5-trinitro-s-triazine) from pink water using the bifunctional quaternary surfactant Duoquad T-50. In addition, all other identified pink water components, except DNB (2,4-dinitrobenzene), were removed by surfactant treatment. Reaction parameters include a pH of 11.5 (with sodium hydroxide solution), reaction temperature of 55 C, surfactant/TNT molar ratio of 0.30 to 0.375, and reactor retention time of one hour per reactor stage. Depending on the requirements for or disposition of the effluent filtrate, trade-offs can be made with overall removal efficiency if heat is not available, practical, or economical by reducing the reaction temperature as discussed. It would be necessary to make concurrent pH increases. The process has two products: a very small amount of co-precipitated explosive-surfactant complex and excess surfactant, which can be easily incinerated, and a filtrate which, after neutralization with sulfuric acid and filtration, can be discharged to conventional wastewater treatment. This process may provide an economic alternative to the use of carbon adsorption for the removal of explosives from wastewater streams from the standpoint of both process costs and disposal of process waste products. Another alternative is a surfactant treatment-carbon adsorption hybrid system, now under evaluation. This process has great potential for incorporation into the waste treatment unit at the new RDX plant to be built at Louisiana AAP. The major components in that process waste stream will be RDX, HMX, SEX, and TAX, all of which can be 100% removed by surfactant treatment. (See also W88-02132) (Lantz-PTT)
W88-02198

PILOT TESTING AND DESIGN OF A HIGH TEMPERATURE AIR STRIPPING SYSTEM FOR MEK REMOVAL,
Hydro Group, Inc., Linden, NJ. Environmental Products Div.
K. M. Sullivan, F. Lenzo, and T. Johnson.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 677-683, 2 fig, 2 tab, 6 ref.

Descriptors: *Pilot plants, *Temperature, *Air stripping, *Methylethyl ketone, *Wastewater treatment, Aquifers, Recovery wells, Design standards, Performance evaluation, Volatile organics, Organic compounds.

The air stripping process has been used successfully in many applications for removal of volatile organic compounds from groundwater supplies, plant process flows, and waste streams. Air stripping has advantages such as simplicity or operation, low capital costs, and very low operation and maintenance costs when compared to other methods of volatile organics removal. One of the few limitations on the process is the range of compounds that are strippable - stripping is economically feasible on compounds such as the chlorinated solvents (TCE, PCE, etc.), lightweight aromatics (benzene, toluene, etc.) nd other easily volatilized compounds. The purpose of this study was to examine the feasibility of stripping less volatile compounds by raising the process temperature to increase their volatility. This study was performed in order to design a modular, portable high temperature air stripping system for use at hazardous material spill sites. The location that prompted the study was a surface aquifer that was contaminated with Methyl Ethyl Ketone (MEK). Approximately 11,360 (3000 gallons) of pure MEK escaped from a tanker trailer and penetrated the aquifer. Earlier ambient temperature stripping tests yielded very poor removal efficiencies. Only a 25% reduction in the MEK levels was achieved using a mobile pilot air stripper. In comparison this same pilot system has removed up to 98% of more volatile compounds such as TCE. Since there was virtually no data available on high temperature stripping, it was decided to perform pilot studies using a sample of water drawn from the most heavily contaminated well. The water was pumped into a 24,600 L (6,500 gallon) holding tank. Since MEK floats on water, the sampling pump was placed just below the water surface in the hopes of obtaining the most heavily contaminated sample. Concentrations at the beginning of the sample recovery were over 4000 mg/L; these decreased to approximately 700 mg/L by the end of the sample collection. The water was yellow and foamy and occasionally a milky-white color. Later analysis showed MEK levels of about 1000 mg/L in the raw water used for the testing. (See also W88-02132) (Lantz-PTT)
W88-02199

DYE SENSITIZED PHOTO-OXIDATION OF BROMACIL IN WASTEWATER,
Tennessee Technological Univ., Cookeville. Center for the Management, Utilization and Protection of Water Resources.
T. N. Eisenberg, E. J. Middlebrooks, and V. D. Adams.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 693-702, 8 fig, 3 tab, 22 ref.

Descriptors: *Wastewater treatment, *Dyes, *Photo-oxidation, *Chemical treatment, Oxidation, Bromocil, Hyvar X-L, Hydrogen ion concentration, Gas chromatography, Dissolved oxygen, Methylene blue, Suspended solids.

At the present time, insufficient information is available for the design of a full scale solar detoxification system. The objective of this study was to provide such information by performing the following tasks: (1) Determine the feasibility of dye sensitized photooxidation for wastewater detoxification in a field situation; (2) Test a refractory and toxic organic compound for degradation by photooxidation; (3) Determine the effects of mixing, dye concentration, dissolved oxygen concentration, pH value, initial substrate concentration, solids settling, light intensity, and detention time on substrate removal; (4) Determine the extent to which the substrate can be removed; and (5) Describe mathematically the rate of degradation observed. Secondary unchlorinated effluent from the City of Livingston, TN Wastewater Treatment Plant was the source of water for the bench scale studies. The water was pumped from the overflow weirs of the secondary clarifier into a series of six 208 L (55 gal) containers. Experiments were conducted during the period of March 20 to April 18, 1985, during which time 6 batch experiments were performed. A total of 36 different operating combinations were investigated using various pH values (adjusted to desired value with 6N NaOH), MB concentrations, initial bromacil concentrations and mixing regimes, and random effects of sunlight intensity and suspended solids. Hyvar X-L (bromacil) extraction efficiency declines at pH values above 9.0. COD analyses were inconclusive due to the volatility of inert ingredients present in the bromacil source. Industrial grade MB (TRICON) is as effective a photosensitizing agent as laboratory grade MB and considerably less expensive. Solids settling enhances substrate removal; however, the removal is due to adsorption of the substrate onto suspended matter, rather than to photooxidation of the substrate. Photooxidation rates are unaffected for bromacil concentrations up to 40 mg/L. At higher concentrations, the DO is depleted and reaction rates decline. Sunlight intensities in the range of 300-900 W/sq m are sufficient to initiate the photooxidation mechanism. (See also W88-02132) (Lantz-PTT)
W88-02201

REMOVAL OF TOTAL TOXIC ORGANICS AT FORD MOTOR COMPANY,
McNamee, Porter and Seeley, Ann Arbor, MI.
S. J. Kang, J. A. Borchardt, J. K. Pugh, and P. R. Lawrence.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 703-709, 8 fig, 6 ref.

Descriptors: *Wastewater treatment, *Volatile organics, *Organic compounds, *Ford Motor Company, Aeration, Spraying, Air stripping, Mathematical studies, Industrial wastewater, Temperature, Chemical reactions, Mass transfer.

Both spray nozzle and surface aeration systems are capable of stripping volatile total toxic organics from the wastewater at Ford Motor Company, Ann Arbor, MI. The nozzle system has the advantage of being compact while the surface aeration system is energy efficient. The critical design factors in the spray nozzle system are nozzle size, air-to-water ratio, nozzle spacing and temperature. A statistical model incorporating these parameters has been developed to aid in design. The critical design factors in the surface aeration system are power-to-volume ratio, type of aerator, temperature, number of stages and detention time. The value of the mass transfer rate constant, depends upon the unit power input, the aeration device and the wastewater temperature. Once a mass transfer rate constant value is determined for an aeration system, the required detention time can be calculated. (See also W88-02132) (Lantz-PTT)
W88-02202

SHOCK LOAD CAPABILITIES OF ANAEROBIC SYSTEMS TREATING HIGH STRENGTH WASTEWATERS,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
E. L. Stover, R. Gonzalez, and G. Gomathinayagam.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 711-718, 5 fig, 3 tab, 8 ref.

Descriptors: *Shock load, *Pollutant load, *Wastewater treatment, *Anaerobic digestion, Biological treatment, Industrial wastewater, Temperature, Hydrogen ion concentration, Aerobic digestion, Nutrients.

High strength industrial wastewaters present a unique challenge to biological treatment processes, especially aerobic systems. Extensive pilot studies with both fixed-film and suspended growth anaerobic systems over the past four years have shown their stability and capabilities of operating under changing conditions relative to substrate removal, effluent quality, gas production, and gas quality. When compared to aerobic systems, these anaerobic systems have demonstrated many advantages relative to 'real world' operational considerations. Accurate prediction and modeling of treatment performance and gas production can be accomplished when substrate utilization and gas production are expressed as a function of the mass substrate loading rate by monomolecular kinetics.The anaerobic systems, when designed and operated properly, produce high treatment efficiencies with stable methane production. At times during shock load studies, the substrate loading rates were doubled for 24 hours with very little effluent substrate leakage and impact on the gas production rates. Temperature and pH were found to be two of the most critical factors. When the pH was allowed to go below 6.5, operational problems were encountered. Decrease in temperature during continuous feeding had significant negative impacts on both effluent quality and gas production. Various investigations on the effects of shock loads due to variations in feed concentration, flow rate, pH, temperature, and nutrients revealed that both types of anaerobic systems (suspended growth and fixed-film) could handle such shocks if the systems were properly monitored and controlled. The studies presented here show the 'real world applicability of designing and operating anaerobic treatment systems for high strength industrial wastewaters. (See also W88-02132) (Lantz-PTT)
W88-02203

ENHANCED COD REMOVAL FROM PHARMACEUTICAL WASTEWATER USING POWDERED ACTIVATED CARBON ADDITION TO AN ACTIVATED SLUDGE SYSTEM,
Rexnord, Inc., Milwaukee, WI. EnviroEnergy Technology Center.
R. A. Osantowski, C. R. Dempsey, and K. A. Dostal.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 719-727, 5 fig, 3 tab, 7 ref.

Descriptors: *Wastewater treatment, *Pharmaceutical industry, *Industrial wastewater, *Activated carbon, *Activated sludge, Biological treatment, Pilot plants, Chemical oxygen demand, Powdered activated carbon, Suspended solids, Mixed liquor solids.

On October 27, 1983, the EPA promulgated final Pharmaceutical Manufacturing Point Source Category Effluent Limitations Guidelines, Pretreatment Standards, and New Source Performance Standards. In this rulemaking, the Agency decided to return to the 1976 Best Practicable Control Technology Currently Available subcategorization scheme, and, as a result, the 1982 proposed COD regulations are no longer a valid point of comparison. A final decision on appropriate Best Available Technology Economically Achievable limitations and NSPS for COD was postponed until additional information could be obtained on applicable COD removal technologies and their achievable concentrations. This paper presents the results of PAC/activated sludge studies for the treatment of pharmaceutical industry wastewater. From September to December, 1984, an eighty-three (83) day study was conducted using a biological pilot plant as the control, and two other biological systems as the experimental (PAC fed) systems. The three activated sludge units were operated in parallel. The objective of this study was to evaluate the effectiveness of powdered activated carbon addition to the activated sludge process to reduce effluent COD concentrations. It was found that PAC addition to the activated sludge process can increase the soluble COD removal from pharmaceutical manufacturing wastewater. The PAC/activated sludge process cannot be recommended as a viable process for this plant's wastewater until the cause of the viscous floating mixed liquor suspended solids is identified and adequate safeguards against its occurrence are demonstrated. (See also W88-02132) (Lantz-PTT)
W88-02204

TREATMENT OF PHENOL-FORMALDEHYDE RESIN WASTEWATERS USING ROTATING BIOLOGICAL CONTACTORS,
Wuhan Inst. of Urban Construction Engineering (China).
C.-W. Huang, Y. T. Hung, and Y.-S. Dong.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 729-746, 11 fig, 13 tab, 3 ref.

Descriptors: *Wastewater treatment, *Formaldehyde, *Rotating biological contactors, *Wuhan, *China, Biological treatment, Phenols, Chemical oxygen demand, Temperature, Pollutant load, Resins.

The wastewaters generated from the Wuhan Chemical Plant, Wuhan, China, contained phenol and inorganic salts from the distillation process, and filtering cloth washing in the phenol plant and phenol, formaldehyde, methanol, and benzene from the phenol-formaldehyde resin plant. Phenol reacts with formaldehyde in the presence of hydrochloric acid as catalyst, undergoes condensation and polymerization to form the final product, the thermosetting resins. Wastewaters produced from these various processes are called the phenol-formaldehyde wastewaters. For phenol formaldehyde resin wastewaters containing 300 mg/L phenol, 200 mg/L formaldehyde, and 1500 mg/L COD, the 1-shaft 4-stage rotating biological contactor (RBC) at a hydraulic detention time of 2.8 hours removed 99.6% phenol, 93% formaldehyde, and 60-90% COD. For wastewaters containing 200-400 mg/L phenol, 250-300 mg/L formaldehyde, and 1500-2000 mg/L COD, the 1-shaft 4-stage and 3-shaft 3-stage RBC in series at a hydraulic detention time of 4.5 hours removed 99.9% phenol, 100% formaldehyde, and 90% COD. For high strength wastewaters, the minimum hydraulic wastewaters, the minimum hydraulic detention time should be 2.8 hours. The 1-shaft 4-stage and 3-shaft 3-stage RBC in series could handle shock loading with a hydraulic detention time of 4.5 hours and a COD surface loading rate of no longer than 38 g/sq m/day. It took 2 days for the 1-shaft 4-stage RBC with a hydraulic detention time of 2.8 hours and a COD surface loading of no larger than 70 g/sq m/day to recover from the shock loading. The design parameters developed in this study were 6.54 g/sq m/day of phenol surface loading, 33.3 g/sq m/day of COD surface loading, 6.4 g/sq m/day of formaldehyde surface loading and 35 L/sq m/day of hydraulic loading. Stripping of phenol and formaldehyde by the RBC process depended upon air temperature and the influent concentration. (See also W88-02132) (Lantz-PTT)
W88-02205

WASTE ACTIVATED SLUDGE DIGESTION WITH THERMOPHILIC ATTACHED FILMS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
U. J. Han, R. M. Kabrick, and W. J. Jewell.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 747-758, 7 fig, 3 tab, 17 ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Thermophilic bacteria, *Anaerobic digestion, Biodegradation, Chemical oxygen demand, Digestion, Retention time, Solids, Separation.

This 1.5 year study was conducted to determine the feasibility of using a thermophilic anaerobic attached film expanded bed process to treat organic slurries such as waste activated sludge. All laboratory reactors were operated at 55C. Completely mixed controls were compared to single-pass expanded beds where the raw untreated activated sludge, or the hydrolyzed activated sludge, was added to the system. The single-stage expanded bed was contrasted to the two-phase system where hydrolysis was used prior to the expanded bed. Completely mixed thermophilic digesters were capable of achieving 95% conversion of biodegradable organic matter in 30 days and 74% conversion in 7.5 days. The total biodegradable fraction of the real waste activated sludge (RWAS) was 57% with an estimated 5-day SRT whereas the laboratory-generated waste activated sludge (LWAS) had a 43% total biodegradable fraction of the total COD with a 10-day solids retention time. A 3-day hydraulic retention time in the hydrolysis, completely mixed unit at 55C resulted in solubilization of 93% of the total COD of the LWAS. Comparable solubilization efficiencies for RWAS were as low as 32%. Good liquid/solids separation resulted during sedimentation with the LWAS but was limited with RWAS. Greater than 80% of the total COD of the soluble fraction in the hydrolysate was converted in the expanded bed in less than 15-hour hydraulic retention time. A 3-day hydraulic retention time in the 55 C hydrolysis unit followed by a 0.6-d HRT expanded bed with or without separation of solids resulted in greater than 85% conversion of the biodegradable COD. (See also W88-02132) (Lantz-PTT)
W88-02206

IN-BASIN CHLORINATION FOR CONTROL OF ACTIVATED SLUDGE BULKING IN INDUSTRIAL WASTE TREATMENT PLANTS,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
H. J. Campbell, D. Troe, R. Gray, D. Jenkins, and C. W. Kirby.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 759-773, 16 fig, 5 tab, 5 ref.

Descriptors: *Chlorination, *Activated sludge, *Wastewater treatment, *Bulking sludge, Wastewater facilities, Polymers, Biological treatment, Chemical oxygen demand, Chlorine.

In-basin chlorination has been used successfully to control activated sludge bulking at three full-scale industrial waste treatment plants. The use of Cl2 for bulking control resulted in prevention of treatment plant upsets which could have led to NPDES permit noncompliance and, in two instances, resulted in considerable cost savings over the prior practice of using polymers. When dealing with filamentous organisms that grow inside the activated sludge floc and cause bulking due to the production of a 'stretched out' diffuse floc, in -basin chlorination can cause some deterioration of effluent quality for both turbidity and soluble COD. These quality deteriorations appear to be related to Cl2 dose; recovery from them is rapid following the reduction and/or cessation of Cl2 dosing. In the cases described here, it was possible to ameliorate the bulking problem using in-basin chlorination without causing effluent discharge limitations to be exceeded. For the 'stretched out' diffuse floc bulking situation, there appears to be a site specific 'threshold level' of chlorine at which filamentous bulking rapidly declines. Before this 'threshold level' is achieved, small changes in the bulking condition are observed; when this level is exceeded significantly, measurable deterioration in effluent quality may be observed. On the one occasion that measurements were made, in-basin chlorination for bulking control did not produce an increase in effluent concentrations of chlorinated organics. (See also W88-02132) (Lantz-PTT)
W88-02207

MODIFIED EXTENDED AERATION PLANT FOR MINIMIZING SLUDGE PRODUCTION,
Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Rozich, and A. F. Gaudy.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 775-784, 4 fig, 6 tab, 8 ref, append.

Descriptors: *Aeration, *Modified extended aeration, *Sludge, *Wastewater treatment, Aerobic digestion, Activated sludge, Digestion, Biological treatment, Design standards, Process control, Costs.

This report describes a modification of the extended aeration process which can be utilized as a method for significantly reducing or possible eliminating both the primary and secondary sludge streams in wastewater treatment plants. The crux of this process modification rests on utilizing an aerobic digester as a source of recycle cells for the aeration tank in an activated sludge process; both primary and secondary sludges are digested in this reactor and no sludge is wasted from this system. Because of the relatively lengthy hydraulic detention time in the aerobic digester, the concentration of recycle sludge becomes relatively constant; consequently, the aeration tank benefits from the constant concentration of recycle sludge control technique. In this report, a preliminary modelling approach is given for this process modification, and it is compared and contrasted with a conventional activated sludge treatment plant scheme. In a cost analysis which compares capital and operating/maintenance costs for a 10 MGD flow rate, the modified process is shown to be significantly more cost-effective than the conventional treatment plant scheme. (See also W88-02132) (Lantz-PTT)
W88-02208

PERFORMANCE OF AN ANAEROBIC FILTER TREATING SOLUBLE CARBOHYDRATE WASTE,
Mass Transfer Systems, Inc., Fall River, MA.
F. J. Siino, F. C. Blane, and J. C. O'Shaughnessy.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 785-793, 12 fig, 3 tab, 10 ref.

Descriptors: *Anaerobic filters, *Carbohydrates, *Wastewater treatment, *Food-processing wastes, Fructose, Chemical oxygen demand, Biological treatment, Filtration, Biological oxygen demand, Suspended solids, Organic compounds, Biomass.

Use of anaerobic filters to treat synthetic soluble carbohydrate wastes was studied. Fructose corn syrup was used as the carbon source to simulate the sweetener used by a typical soft drink bottling company. Soft drink bottling waste characteristics are typically very low in suspended solids with soluble COD concentrations ranging from 1,000 to 6,000 mg/L. The anaerobic filter is applicable to the treatment of soluble fructose waste. It would be applied to the soft drink bottling industry as a pretreatment process. The filter could convert a substantial amount of the influent COD with very little power input. The methane produced co8uld be used to assist in heating the filter. The second stage (aerobic process) could be used to meet NPDES limitations for BOD and suspended solids. For 200 days of continuous flow, the maximum organic removal rate was 298 lbs COD/1000 cu ft/day at an influent organic loading of 466 lb/1000 cu ft/day. A filter operating at a 41 hour (1.7 day) hydraulic retention time was able to remove 85-90% of the 1,200 to 6,000 mg/L soluble COd. The 137 day solids retention time developed in this particular filter appears to be sufficient to handle the range of influent waste strength from a soft drink bottling operation. Approximately 77% of all biomass was in the first section (stage) of the filter. This correlates with the high degree of soluble substrate stabilization in this bottom section. (See also W88-02132) (Lantz-PTT)
W88-02209

EVALUATION OF BIODEGRADATION KINETICS FOR PRIORITY POLLUTANTS,
Engineering-Science, Fairfax, VA.
D. M. Philbrook, and C. P. L. Grady.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 795-804, 6 fig, 2 tab, 25 ref. NSF Grant No. CEE-8116870.

Descriptors: *Performance evaluation, *Kinetics, *Wastewater treatment, *Biodegradation, Priorities, Modified infinite dilution test, Biomass, Organic carbon.

The application of reactor engineering techniques with appropriately variable kinetic parameters will allow explicit evaluation of probable changes in removal efficiency. Once the engineer and operator can predict what is likely to occur, then they

can use their judgement and the art of engineering to do the best job possible. Without such analyses, however, they cannot make rational decisions and the results of their efforts will be less than optimal. Available techniques for measuring the kinetics of priority pollutant removal were evaluated to propose modifications which make it both rapid enough and easy enough to provide the type of data needed by the designer and the operator. It was found that the modified infinite dilution tests allows rapid determination of the kinetic parameters describing biodegradation of priority pollutants. Use of the infinite dilution test allows explicit measurement of the day-to-day variability in removal capability of a given biomass for a priority pollutant. The presence of other carbon sources during measurement of biodegradation kinetics greatly increases the variability in the observed parameters. (See also W88-02132) (Lantz-PTT)
W88-02210

MEMBRANE TECHNIQUE FOR BIOMASS RETENTION IN ANAEROBIC WASTE TREATMENT PROCESSES,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
C. B. Saw, G. K. Anderson, A. James, and M. S. Le.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 805-811, 10 fig, 14 ref.

Descriptors: *Membrane filters, *Biomass, *Wastewater treatment, *Anaerobic digestion, Mixed liquor solids, Biological treatment, Solids, Digestion, Ultrafiltration.

A new concept of operating completely mixed digesters using crossflow filtration units for biomass retention is presented. To date, one of the major difficulties in anaerobic digestion has always been to retain a sufficient quantity of active biomass in the reactor. In anaerobic systems, the microorganisms reproduce less rapidly than in aerobic systems and a longer minimum SRT (solids retention time) is required to accomodate the slower net growth rate. Numerically, the reciprocal of the SRT is the net growth rate of the system. For the system to function satisfactorily, the reciprocal of the design SRT of the process must be in excess of the minimum time it takes for the microorganisms to reproduce in the process. Below this minimum SRT, the microbial cells will be washed out of the system at a faster rate than they can multiply and the system fails. These limitations can be overcome be retaining the biomass within the digester for periods longer than the waste undergoing digestion thereby increasing the density of the bacterial populations in the reactor. In the contact process, a settlement tank is used to concentrate and recycle the biomass to the digester. However, settling is not an efficient process at high MLSS (above 10000 mg/L), and hence it limits the range of loading rates which can be used. Both ultrafiltration and the new generation of highly asymmetric microporous membranes were shown to be useful for biomass/effluent separation. However, on average, microporous membranes yield about 40% higher flux than ultrafiltration membranes. A new design of crossflow microfiltration equipment capable of handling high solids concentration has been found suitable for biomass retention in anaerobic digesters. (See also W88-02132) (Lantz-PTT)
W88-02211

APPLICATION OF THE SPINNING DISC REACTOR AS AN OZONE CONTACTOR,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
C. B. Saw, G. K. Anderson, C. R. Howarth, and J. E. Porter.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 813-823, 11 fig, 17 ref.

Descriptors: *Ozonation, *Spinning disc reactor, *Ozone contactors, *Wastewater treatment, Ozone, Ultraviolet radiation, Biological oxygen demand, Chemical oxygen demand, Organic carbon, Color, Turbidity, Suspended solids, Oxyphotolysis, Photolysis.

Studies carried out in the U.S.A. have ascertained that ozone utilization could be increased by using ultraviolet radiation in conjunction with ozone. Because of the low bond strength of ozone and its large absorption coefficient in the U.V. range, one would expect a photochemical change to occur. The method by which ultraviolet radiation enhances the oxidation of organic molecules appears to be two-pronged. First, ultraviolet energy decomposes ozone molecules to reactive oxygen atoms and diatomic oxygen. These, along with intact ozone molecules, attack the organic species present and oxidize them. Secondly, ultraviolet energy activates some organic species, thus rendering them more susceptible to oxidation. Excitation of the molecules occurs and free radicals are produced which are very reactive in the presence of ozone. Therefore, if the treatment time and amount of ozone required could be reduced, an extremely efficient technique might be achieved. It has been previously shown that the use of ozone alone as a tertiary treatment process for wastewaters results in increased biodegradability and a reduction in BOD, COD, TOC, color, turbidity, and suspended solids. The spinning disc reactor was further used in this work to study the oxyphotolysis (ozone/U.V. oxidation) of wastewaters. The main dimensionless variable which are applicable to describe the flow of liquid on a spinning disc have ben identified and used in the derivation of mass transfer equations for assessing the performance of the spinning disc reactor. It has been shown that the high mass transfer rates attained are due to the bulk mixing action of the ripples at the free surface of the liquid film and not to the increase of interfacial area due to the ripples. The authors have previously shown that ozone in conjunction with a spinning disc reactor is particularly useful for tertiary treatment of municipal and industrial effluents. The formation of ripples on a liquid film flowing across a spinning disc results in an extremely efficient method of simultaneous 'exposure' and 'mixing', enabling the liquid to be brought into intimate contact with the gaseous phase for particle oxidation or disinfection and simultaneous liquid phase reaction. (See also W88-02132) (Lantz-PTT)
W88-02212

REGULATION OF THE SYNTHESIS OF THE DENITRIFYING ENZYMES IN ACTIVATED SLUDGE,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
T. J. Simpkin, and W. C. Boyle.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 825-835, 1 fig, 4 tab, 22 ref.

Descriptors: *Denitrification, *Enzymes, *Activated sludge, *Wastewater treatment, Biosynthesis, Microbiological studies, Biochemistry, Chemical analysis, Municipal wastewater, Nitrates.

A conceptual model illustrates the biochemical and microbiological regulation of activated sludge traits. Denitrification is used as an example of how the model would operate based on biochemical and microbiological theory. To determine the actual configuration of the model for activated sludge, an assay for the denitrifying enzymes was developed. This assay is described along with results which give clues as to the importance of enzyme synthesis in regulating the denitrifying enzymes. The denitrifying enzyme assay reported does not provide direct information about the kinetics of denitrification in-vitro. The levels of the denitrifying enzyme activity that limit the rate of denitrification depend on the organic strength of the waste. An activated sludge system receiving a dilute municipal wastewater may not be limited by a certain level of enzyme activity that would limit a system receiving a more concentrated waste such as an industrial waste. Municipal systems also may have enzyme activity entering the system with the waste. This activity may be sufficient to keep from limiting the rate of denitrification with the dilute wastewater. A general conclusion may be drawn about the synthesis of the denitrifying enzymes in nitrifying systems. The results presented above suggest that a nitrifying activated sludge will provide sufficient nitrate and anoxic sites (in the clarifiers or in microsites in the floc) for synthesis of the denitrifying enzymes to be 70-100% complete. Thus, in contrast to some theories, repression of the enzymes should not be the most important effect that oxygen has on denitrification. Regulation at the level of enzyme activity (inhibition) is a more likely reason for oxygen to limit denitrification. (See also W88-02132) (Lantz-PTT)
W88-02213

ACTIVATED SLUDGE TREATMENT OF A HIGH STRENGTH NITROGENOUS WASTE,
Virginia Military Inst., Lexington. Dept. of Civil Engineering.
R. O. Mines, and J. H. Sherrard.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 837-846, 8 fig, 4 tab, 33 ref.

Descriptors: *Activated sludge, *Wastewater treatment, *Nitrogenous wastes, Biological treatment, Ammonia, Fertilizers, Nitrogen, Chemical oxygen demand, Kjeldahl nitrogen, Dissolved oxygen.

Relatively few studies have been performed on the fate of ammonia in wastewaters from the fertilizer, coking, petroleum and refining, and organic chemical industries wastewaters containing a high concentration of ammonia. This laboratory research investigation was undertaken to evaluate the fate of nitrogen when treated in an activated sludge process at a high initial ammonia. It was revealed that higher organic carbon removal efficiencies were obtained from experimental dat on R-1 operating at a COD:TKN ratio of 6:07:1. Lower carbon removal at a COD:TKN ratio of 0.65:1 most likely resulted from inhibition as a result of the high concentration of free ammonia and nitrite present in the mixed liquor. R-2 was theoretically designed to operate under a carbon limitation at low mean cell residence times and under a dissolved oxygen limitation at high sludge ages. The low DO levels suggest that R-2 was indeed operating under a dissolved oxygen limitation at high sludge ages. Nitrification can be inhibited when insufficient amounts of oxygen are supplied to the process and a nitrite buildup can result. Total mixed liquor suspended solids concentrations increased for both COD:TKN ratios studied as sludge age was increased. TKN and NH3 removal efficiencies were greater at the higher COD:TKN ratio of 6.07:1. The percent distribution of effluent nitrogen was considerably different for R-1 and R-2. Experimental data collected on R-1 indicated that a NO3(-)-N accumulation would occur whereas a nitrite buildup would result for R-2. A DO limitation which existed in R-2 at high mean cell residence time of the total system values resulted in Nitrobacter being inhibited and therefore caused a buildup of nitrite. (See also W88-02132) (Lantz-PTT)
W88-02214

REMOVAL OF AZO DYES BY THE ACTIVATED SLUDGE PROCESS,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
G. M. Shaul, C. R. Dempsey, and K. A. Dostal.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 847-854, 2 fig, 4 tab, 15 ref.

Descriptors: *Azo dyes, *Activated sludge, *Wastewater treatment, *Fate of pollutants, Dyes, Sludge, Nitrogen, Sodium, Sulfur, Aromatic compounds, Amines, Organic compounds, Biological treatment, Chemical analysis, Biodegradation.

The Water Engineering Research Laboratory, Office of Research and Development, U.S. EPA is conducting research designed to develop techniques for predicting the fate of azo dyes in typical wastewater treatment systems which are treating wastewater contaminated with azo dyes. These

techniques are being developed for EPA Office of Toxic Substance's use in the Premanufacture Notification review process under section 5 of the Toxic Substances Control Act and potentially in the regulation of hazardous chemical substances and mixtures under TSCA Section 6. A part of this research involves pilot plant investigations on the removal of azo dyes by the activated sludge process. Generally, azo dyes contain between one and four azo linkages (-N=N-), linking phenyl and naphthyl radicals that are usually substituted with some combination of functional groups including: amino (-NH2), chloro (-Cl), hydroxy (-OH), methyl (-CH3), nitro (-NO2) and sulfonic acid, sodium salt (-SO3Na). Azo dyes are of concern to OTS because some of the dyes, dye precursors or their degradation products such as aromatic amines, which are also dye precursors, have been shown to be, or are suspected to be, carcinogenic. Therefore, the principle objective of this research project is to determine the fate of the dye compounds in the activated sludge treatment process. The results from this research are needed by OTS to aid in predicting the degree to which new azo dyes and/or their degradation products pass through the activated sludge process. This report presents background information and results to date (5/85) for this ongoing project which is being performed at the EPA's Test and Evaluation Facility in Cincinnati, Ohio. (See also W88-02132) (Lantz-PTT)
W88-02215

BIOLOGICAL TREATMENT OF SOY SAUCE FERMENTATION WASTE - COMPUTER SIMULATION OF FILL-AND-DRAW ACTIVATED SLUDGE SYSTEM,

Bureau of Environmental Protection, Taipei (Taiwan).
C.-J. Liu.

IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 855-869, 13 fig, 11 tab, 6 ref.

Descriptors: *Wastewater treatment, *Biological treatment, *Soy sauce, *Model studies, *Computers, *Fill-and-draw, *Activated sludge, Simulation analysis, Computer models, Industrial wastes, Mathematical models, Aeration.

A mathematical model was calibrated with the results of treatability studies performed on soy sauce fermentation wastewater to simulate the fill-and-draw activated sludge operation, to study the influence of the filling time on effluent quality. In the past, when applied to a full scale operation such as a municipal wastewater treatment plant, the fill-and-draw procedures were considered tedious and required too much labor to perform manually. In contrast, in a continuous activated sludge system, the aeration reactor is continuously fed with raw wastewater and the aerated liquid is continuously discharged into a separate clarifier where the sedimentation of biomass is performed. The separated biomass is then partially returned to the aeration reactor, and the remaining portion is wasted. Thus, the continuous-flow activated sludge has been extensively employed for treating municipal and industrial wastewaters. With the advent of the microprocessor and microcomputer, the steps for operating a fill-and-draw activated sludge system could be performed easily. Thus, this process has been revived for treating industrial wastewaters that are of relatively small volume and exhibit large variations in both flow rate and concentration. The main advantage of a fill-and-draw activated sludge system is its flexibility. The operation of this system needs not approach a so-called steady-state, thereby eliminating the step of equalizing the influent wastewater. (See also W88-02132) (Lantz-PTT)
W88-02216

DEVELOPMENT OF AN ANAEROBIC TREATMENT PROCESS FOR WASTEWATERS CONTAINING HIGH SULFATES,

Duncan, Lagnese and Associates, Inc., Pittsburgh, PA.
M. Olthof, W. R. Kelly, J. Oleszkiewicz, and H. G. Weinreb.

IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 871-877, 4 fig, 7 tab, 10 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Sulfates, BIOSULFIX, Sodium biosulfide, Methane bacteria, Sulfur bacteria, Hydrogen sulfide, Methane, Biological treatment, Fertilizers, Phosphorus, Biological oxygen demand.

Three applications of the 'BIOSULFIX' process are discussed for the anaerobic treatment of high strength waste streams. The presence of sulfates has been considered to be a nuisance. The sulfate reducing bacteria (SRB) reduce sulfates to the sulfides that create a toxic environment for the methane forming bacteria (MFB). Furthermore, the sulfides in the gas are considered to be a nuisance causing potential corrosion problems and resulting in undesirable sulfur oxide releases. The 'BIOSULFIX' process degrades the organics and forms a valuable by product in the form of sodium bilsulfide. This process can adequately take care of the sulfides that are formed by the SRB. At the same time the environment in the bioreactor is such that the MFB can also perform. The type of organics and ratio of organics to sulfates in the waste will determine the ratio of hydrogen sulfide and methane in the gas formed. The potential commercial applications for this process are numerous. There are a large number of high strength (BOD) industrial waste streams that are unsuitable for direct methane digestion because of the high sulfate concentration. For such situations it is possible to use the SRB to oxidize the organics while at the same time produce useful sulfur products. Another application is for sulfur recovery from gypsum sludges from powerplants and the phosphoric acid fertilizer industry in the presence of organic waste such as undigested municipal sewage sludge. (See also W88-02132) (Lantz-PTT)
W88-02217

IMPROVED INDUSTRIAL WASTEWATER TREATMENT THROUGH PARTICLE SIZE MANAGEMENT USING LEACHATE TREATMENT AS A CASE STUDY,

California Univ., Davis. Dept. of Civil Engineering.
A. D. Levine, G. Tchobanoglous, W. M. Copa, and G. Garzonetti.

IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 879-889, 7 fig, 6 tab, 22 ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Particle size, *Leachates, *Case studies, Chemical analysis, Process control, Costs.

Treatment of industrial wastewater can be improved by effective characterization of the size distributions of wastewater contaminants. For each wastewater treatment operation and process, an optimal size range exists over which effective treatment can occur. Therefore, size characterization of waste contaminants can be used to facilitate the selection and design of appropriate cost-effective treatment technologies for the treatment of industrial wastes. The results of size characterization analyses can be used as an adjunct to conventional wastewater characterization tests to obtain more specific information regarding the waste to be treated. Using leachate treatment as a case study for size characterization, the contaminants in leachates can be grouped into four size ranges. Because the chemistry of each leachate is dependent on local size characteristics, the use of size ranges is a less cumbersome way of characterizing leachates than the use of lists of compounds or the use of nonspecific measurements. Further size characterization methods are useful for monitoring leachate changes with time. The major benefit of using particle size management in industrial waste treatment is the development of an improved basis for the selection and design of treatment process flowsheets. Ultimately, the use of the concepts of particle size management can lead to more efficient operation of treatment processes and reduced treatment costs. (See also W88-02132) (Lantz-PTT)
W88-02218

MOLASSES PROMOTED BIOLOGICAL SULFUR RECOVERY FROM HIGH SULFATE WASTES,

University of Southern California, Los Angeles. Dept. of Civil Engineering.
A. Lebel, H. C. G. Nascimento, and T. F. Yen.

IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 891-896, 3 fig, 5 tab, 17 ref.

Descriptors: *Molasses, *Sulfur, *Biological treatment, *Sulfates, *Wastewater treatment, Sulfur bacteria, Organic acids, Lactates, Bacteria, Ion chromatography, Sugars, Inorganic compounds.

The use of an advanced ion chromatography system allowed a thorough investigation of the optimal nutrition requirement in the sulfate reduction system in a new approach. It introduced the ability to simultaneously analyze organic acid and inorganic anions in less than 25 minutes and, thus, allowed a detailed study of the metabolic behavior of the SRB. The work presented in this paper discussed the alternative carbon sources to SRB and studies one of the most attractive sources, molasses, and its applicability to the process. The study of citrus molasses utilization by SRB proved to be highly effective. The sulfate reduction was supported by simultaneous lactate production. Therefore, the experimental condition can simulate a real life situation (also indicated by the high sulfate loading) to demonstrate how well could the process be applied in the industry. The phenomenon of co-existence of lactate producing and sulfate reducing organisms is very significant to the process. It indicates that the lactate production can take place simultaneously with the sulfate reduction in a single reactor. Therefore, the economics of the process will be greatly improved. The use of the advanced ion chromatography system had greatly benefited the research by providing a complete analysis of the major species affecting the process. It enabled a thorough investigation of the metabolic behavior of the SRB. IT further demonstrated its capability to analyze a wide spectrum of chemical species including: sugars, organic acids, inorganic ions, etc. This analysis method is recommended for similar biological studies as an essential tool for the determination of metabolic pathways. (See also W88-02132) (Lantz-PTT)
W88-02219

IMPACT OF SELECT INDUSTRIAL WASTE COMPONENTS ON BIOLOGICAL PHOSPHORUS REMOVAL,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
S. C. Chiesa, J. A. Postiglione, and S. R. Linne.

IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 897-903, 10 fig, 1 tab, 6 ref.

Descriptors: *Industrial wastewater, *Biological treatment, *Wastewater treatment, *Phosphorus removal, Aerobic digestion, Anaerobic digestion, Cyanide, Aeration.

As a first step in assessing the impact of industrial wastes on organisms associated with bio-P removal, this investigation was undertaken to examine the response of bio-P cultures to infrequent or slug dosing of potentially inhibitory, industrially relevant wastewater constituents. It is anticipated that any bio-P removal system proposed for a waste stream containing a more continuous supply of potentially inhibitory compounds be examined on pilot-scale prior to final process selection. The slug discharges emulated in this study can be envisioned as the result of either an accidental spill or a breakdown in on-site pretreatment systems. Aerobic phosphorus uptake appears much more sensitive to the presence of industrial waste components than does anaerobic phosphorus release. Materials such as cyanide which interfere with microbial electron transport systems can completely inhibit phosphorus uptake when present in sufficiently high concentrations. Phosphorus release is unaffected, and a one day process upset may result in a monthly average effluent violation even if all other

values are < 0.5 mg/L. Recovery from industrial 'slug' inputs is rapid with effluent phosphorus concentrations returning to background levels within 48 hours. The effect of some industrial inputs can be minimized by providing aeration during the normally anaerobic mix period. Selection of any bio-phosphorus removal system should take into account the ability of that reactor configuration to deal with any anticipated industrial wastewater inputs. A viable early warning system and a flexible approach to deciding when and where aeration is provided on an emergency basis would enable treatment plant personnel to effectively deal with some intermittent industrial waste inputs. The concentration of inhibitory compounds necessary to cause significant ortho-P uptake should be compared to concentrations anticipated in a combined domestic/industrial feed stream to determine if collection system dilution and equalization will also mitigate potential adverse effects on the bio-P removal system. (See also W88-02132) (Lantz-PTT)
W88-02220

ANAEROBIC PRETREATMENT OF CORN ETHANOL PRODUCTION WASTEWATER,
Biothane Corp., Camden, NJ.
J. Lanting, and R. L. Gross.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 905-914, 6 fig, 3 tab, 8 ref.

Descriptors: *Anaerobic digestion, *Pretreatment of wastewater, *Ethanol, *Wastewater treatment, Industrial wastewater, Biothane process, Chemical oxygen demand, Biological oxygen demand, Sludge, Load distribution, Biomass, Nitrogen, Phosphorus, Hydrogen ion concentration.

A five-month pilot study utilizing a six cu m Upflow Anaerobic Sludge Blanket Biothane digester was recently performed on site of South Point Ethanol, a corn ethanol producer in Southern Ohio. After a full 21 weeks of on-site pilot testing, it has been demonstrated that the Biothane system is a very effective pretreatment system for the wastewater generated by South Point Ethanol. COD and BOD removals averaged over the entire pilot study were 76% and 88%, respectively, at a volumetric loading of 9.3 kg COD/cu m/d. The Biothane system has demonstrated its ability to accept large fluctuations in loadings, temporarily even as much as triple or quadruple the design operating loading without detrimental effect on subsequent performance. Shockloadings can be monitored and reacted to in sufficient time to prevent serious overloading conditions from occurring while maintaining optimum conversion of waste material. The wastewater was nutrient deficient. Addition of nitrogen and phosphorus will be required in a full-scale system. Caustic was needed for pH control at a rate of about 0.08 kg NaOH/kg TCOD entering the anaerobic system. Over design of the caustic dosing system was shown to be a crucial element in the ability of the anaerobic process to successfully overcome periods of shockloading. It has been shown that the anaerobic effluent was every amenable to aerobic polishing with trickling filters. The average total and soluble BOD concentrations before final clarification were 69 mg/L and 19 mg/L, respectively. Since full scale polishing will include a second stage trickling filter and clarification, a very high quality final effluent is expected. (See also W88-02132) (Lantz-PTT)
W88-02221

EVALUATION OF PERCENT REMOVAL VARIABILITY FOR PRIORITY POLLUTANTS IN POTWS,
Indiana Univ. Northwest, Gary. Lab. for Environmental Research.
M. T. Unger, and R. E. Claff.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 915-924, 2 fig, 2 tab, 8 ref.

Descriptors: *Publicly owned treatment works, *Wastewater treatment, Wastewater facilities, Performance evaluation, Monitoring, Metals, Organic compounds, Activated sludge, Trickling filters, Chromium, Copper, Mercury, Zinc.

A statistical approach was used to evaluate the percent removal of priority pollutants in publicly owned treatment works (POTWs). Percent removal data were obtained from POTWs monitored as part of an EPA study of the occurrence and fate of priority pollutants in 40 POTWs. Percent removals of priority pollutants vary significantly among the 40 POTWs tested for both metals and organics. Metal removals ranged from 32 to 81% while organic removals ranged from 52 to 87%. Percent removals for a given priority pollutant are highly variable from plant to plant and even from sampling to sampling within a given treatment plant. Metal variability among plants ranged from plus or minus 21 to 64% while organic variability ranged from 10 to 55%. A linear correlation ca be expressed between percent removal and the coefficient of variation. Analysis of variation has shown significant differences in percent removals of priority pollutants among POTWs. Significant differences in removal rates were also found among activated sludge plants and among trickling filter plants. Analysis of variance revealed no significant differences between the activated sludge and trickling filter treatments for most of the organic pollutants tested; whereas, significantly better removals by activated sludge plants were shown for Cr, Cu, Hg, and Zn. The above findings support the conclusion that percent removal data vary among POTWs and require evaluation on a plant-by-plant basis rather than on mean percent removals which are representative of all treatment plants. (See W88-02132) (Lantz-PTT)
W88-02222

PERFORMANCE EVALUATION OF THE ANAEROBIC FLUIDIZED BED BIOFILM REACTOR: METHANE PRODUCTION FROM GLUCOSE,
National Cheng Kung Univ., Tainan (Taiwan). Dept. of Environmental Engineering.
S. J. Chen, C. T. Li, and W. K. Shieh.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 925-936, 13 fig, 3 tab, 21 ref.

Descriptors: *Anaerobic digestion, *Biofilm reactors, *Methane, *Glucose, *Wastewater treatment, *Fluidized beds, Fluidized bed process, Chemical oxygen demand, Biodegradation, Performance evaluation, Biological treatment, Biomass.

The anaerobic fluidized bed biofilm reactor (AFBBR) was investigated for treatment of a wide variety of municipal and industrial wastewaters. A full-scale AFBBR is currently under operation in the U.S. for treatment of soy processing wastewater. This full-scale facility consists of four 20 ft diameter by 41 ft high single-phase fluidized bed reactors with a total design capacity to remove over 34,000 lb COD/day. This reported gas production rate is 5.4 cu f CH4/lb COD removed. This paper investigates and discussed the efficacy of the AFBBR for methane production from simple and biodegradable substrate with emphasis placed on the discussion of substrate utilization, methane production, and biomass holdup. Glucose was used as the main substrate in the investigation described herein. The results of a laboratory-scale AFBBR investigation demonstrate that this innovative process is highly effective for methane recovery from soluble and biodegradable substrates. An AFBBR is capable of achieving a high COD removal efficiency. COD removal efficiency in excess of 90% is achieved at a COD loading of about 35 kg/cu m/day. Low strength as well as high strength soluble and biodegradable substrates can be equally removed in an AFBBR with a high utilization efficiency provided that the COD loading applied is controlled at a desirable level. Neither the feed COD nor the HRT alone would significantly affect the performance of an AFBBR. About 332 L (15 moles) of methane is produced/kg COD removed. An AFBBR is capable of achieving a very high reactor biomass holdup through the immobilization of microorganisms on the fluidized media, even at a low feed COD concentration so long as the COD loading applied is sufficiently high. (See W88-02132) (Lantz-PTT)
W88-02223

ACCUMULATION OF MUTAGENIC POLYCYCLIC AROMATIC HYDROCARBONS IN BIOLOGICAL SLUDGE,
North Dakota Univ., Grand Forks. Energy Research Center.
C. J. Moretti, and R. D. Neufeld.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 937-947, 4 fig, 7 tab, 19 ref. DOE Grant No. DE-AC22-81FC1-299.

Descriptors: *Aromatic hydrocarbons, *Sludge, *Biological treatment, *Wastewater treatment, Mutagens, Organic compounds, Hydrocarbons, Activated sludge, Mathematical studies, Adsorption, Trihydrononane, Model studies, Toxicity, Sludge, Suspended solids, Volatile solids.

The absorption of polyaromatic hydrocarbons (PAH) into biological sludge was modeled as a two-phase liquid-liquid partitioning phenomenon in which PAH distribute between the wastewater and the sludge lipid fraction. Using this approach, PAH partitioning in an activated sludge system was quantified in terms of an equilibrium distribution coefficient. An equation was developed to predict distribution coefficient values for specific PAH. Batch adsorption experiments were performed to verify the predictive equation, and it was found that calculated distribution coefficient values matched quite well with experimentally-measured values for a range of different PAH. A bench-scale activated sludge system was then operated to study PAH partitioning during the treatment of fixed-bed coal gasification wastewater. Trihydrononane was found to be the best theoretical solvent to use to model PAH uptake into biological sludge in the activated sludge system. Mutagenicity tests were performed on the sludge from the biological treatment system. Sludge mutagenicities for this system were typically found to be several times higher than mutagenicities measured for municipal wastewater treatment biological sludges. The measured sludge mutagenicities were correlated with the pure compound mutagenicities of the PAh present in the sludge in order to establish a link between the PAH content of the sludge and its actual mutagenic potential. A summary equation was then developed which used the PAH distribution coefficient, the mutagenicity correlation, and the PAH concentrations of the activated sludge effluent wastewater to predict the mutagenic potential of the sludge in units of revertants/microL VSS (volatile suspended solids). This equation can be used as means of estimating the mutagenicity of the sludge produced by the activated sludge system from routing aqueous PAH measurements. (See W88-02132) (Lantz-PTT)
W88-02224

DEVELOPMENT OF BIOFILM IN THE ANAEROBIC ROTATING BIOLOGICAL CONTACTOR PROCESS,
Northeastern Univ., Boston, MA. Dept. of Civil Engineering.
M. J. Laquidara, F. C. Blanc, and J. O'Shaughnessy.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 949-958, 9 fig, 7 tab, 8 ref.

Descriptors: *Biofilms, *Anaerobic digestion, *Wastewater treatment, *Anaerobic rotating biological contactors, Process control, Design standards, Growth kinetics, Biological studies, Chemical oxygen demand, Films, Color, Biological treatment.

The configuration of the Anaerobic Rotating Biological Contactor (AnRBC) process is very similar to the aerobic rotating biological process except that the reactor is covered and sealed, an anoxic atmosphere exists above the liquid surface, and disk submergence is greater than in aerobic systems since oxygen transfer is not a consideration. The objectives of this study were to develop

design information with respect to biofilm attachment patterns for the AnRBC process. Information such as attached biofilm growth kinetics, attached biofilm characteristics and properties, and sloughed biofilm properties and characteristics were evaluated. Two pilot-scale AnRBC units which were housed in a temperature controlled room set at 35 C were utilized in the study. Attachment doubling times of 13 to 30 days for the attached biological film were observed. Maximum attachment rates for the attached biological film were observed at organic loading rates between 20 and 50 gm COD/sq m/day. Maximum average growth quantities of 4.2 mg dry mass/sq cm and 60 mg wet mass/sq cm were observed for this system after one year operation. Maximum average wet thickness of 1 mm for sections removed from the system were observed. Actual filament lengths of 2 to 3 mm were visually observed. Therefore, disk spacing should be at least 6 mm if bridging is not desired. For engineering purposes, projected times to develop 75% of attached equilibrium biomass at a loading of 60 gms COD/sq m/day for this system appear to be approximately 100 days. Visual observations show that the biofilm's color changes as a function of applied organic loads. No detectable physical change, as measured by wet/dry mass ratios, other than color was observed in the biofilm as a function of applied organic load and film age. Organic carbon in the biofilm, as measured by COD on a dry weight basis increased as organic loading rates were increased. Settling rates for the naturally sloughed biofilm of 2 to 3 cm/min were observed at all organic loading rates and biofilm development times. (See W88-02132) (Lantz-PTT)
W88-02225

AUTOTHERMAL THERMOPHILIC AEROBIC DIGESTION IN THE FEDERAL REPUBLIC OF GERMANY,
Weston (Roy F.), Inc., West Chester, PA.
K. Deeny, J. Heidman, and J. Smith.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 959-968, 4 fig, 3 tab, 24 ref.

Descriptors: *Autothermal thermophilic aerobic digestion, *Wastewater treatment, *West Germany, Aerobic digestion, Biological treatment, Performance evaluation, Temperature, Volatile solids, Cost analysis, Sludge digestion, Sludge, Digestion.

In West Germany, three variations of thermophilic aerobic digestion systems have been constructed on a full-scale. These include systems marketed by: (1) Fuchs Gas and Wassertechnik GmbH and Co. K.G.; (2) Thieme UmwelHecknik GmbH; and (3) Babcock (Deutsche Babcock analgen Aktingesulschaft). Of these manufacturers, Fuchs is the leading supplier of these systems with approximately 13 of the 17 facilities in West Germany and Switzerland (per the manufacturer). Due to the number of systems installed and the early research and development work performed, the autothermal thermophilic aerobic digestion (ATAD) systems that are visited were all systems supplied by Fuchs. Thieme and Babcock installations were discussed with manufacturer's representatives and data were solicited while in Germany. Process performance factors were generally found to be acceptable. These included: volatile solids retention > 40%, thermophilic (>43 C) temperature conditions in the second stage reactor, apparent pathogen reduction, and infrequent incidence of odors. Additionally, cost analyses performed in West Germany have indicated that the ATAD system in the most cost effective alternative for sludge digestion (compared to conventional aerobic and anaerobic digestion) for facilities of small to medium size (<4 MGD). The cost comparison made as a result of this ATAD assessment indicates that this relationship may hold true for the U.S. as well. It is important to note that no consideration was given to the benefit of achieving 'pasteurization' of the sludge during cost comparisons performed in West Germany or in the U.S. Typically, an additional process (i.e., gamma irradiation) may be required to achieve similar levels of sludge quality. This benefit may significantly increase the apparent cost benefits of the ATAD process. (See W88-02132)
W88-02226

APPROACH TO EUTROPHICATION PROBLEMS CLOSE TO AN EXPANDING METROPOLIS IN AUSTRALIA,
VBB/SWECO Consulting Group, Stockholm (Sweden).
For primary bibliographic entry see Field 5G.
W88-02243

ENVIRONMENTAL REGULATIONS AND TECHNOLOGY, THE NATIONAL PRETREATMENT PROGRAM.
Environmental Protection Agency, Washington, DC. Office of Water Enforcement.
Technology Transfer Report No. EPA/625/10-86/005, July 1986. 27 p, 15 fig, 3 tab, 11 ref.

Descriptors: *Pretreatment of wastewater, *Industrial wastewater, *Water pollution control, Municipal wastewater, Regulations, National programs, Federal jurisdiction.

Undesirable effects resulting from the discharge of industrial wastewater into municipal sewers can be prevented. Industrial plants, using proven pollution control technologies, can remove pollutants from their wastewaters before discharging them into the municipal sewage treatment system. This practice is known as 'pretreatment.' Industry is already pretreating its wastewater in many communities. The National Pretreatment Program, a cooperative effort of federal, state, and local officials, is implementing this practice on a nationwide basis. By reducing the level of pollutants discharged by industry into municipal sewage systems, the program ensures that industrial development vital to the economic well-being of a community will be compatible with a healthy environment. This document explains the need for the National Pretreatment Program; describes a federal, state, and local roles in the program's implementation; and explores the program's future. (Lantz-PTT)
W88-02267

INTERNATIONAL CONFERENCE ON APPLICATION OF ADSORPTION TO WASTEWATER TREATMENT, PROCEEDINGS.
February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. 615 p. Edited by W. Wesley Eckenfelder.

Descriptors: *Adsorption, *Wastewater treatment, Regulations, Process design, Economic aspects, Costs, Water reuse, In situ regeneration.

The need for technology for cost effective removal of toxic materials from wastewaters will not abate. This need is real, but the regulatory framework based on past performance cannot identify adsorption technology as the technological basis for waste water limitations unless it can be shown to be applicable on a broader than case-by-case basis. The technology-based regulatory program drives a conventional treatment market, and that market is becoming mature. With this regulatory perspective in mind, it is suggested that a broader application at lower cost is needed. Both the science of adsorption principles and the engineering of reduced cost must be investigated more aggressively. The areas of investigation could include: hierarchal adsorbate displacement, insitu regeneration, continuous process design, more efficient or lower cost regeneration technology, adsorbate recovery/reuse concepts, in-plant uses, more effective adsorbants, and prediction of applications in wastewater treatment. Each paper presented in this book discusses one or more of these points. (See W88-02285 thru W88-02311) (Lantz-PTT)
W88-02284

CONCEPTS AND PRINCIPLES OF CARBON APPLICATIONS IN WASTEWATER TREATMENT,
Michigan Univ., Ann Arbor.
W. J. Weber.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 5-28, 7 fig, 63 ref.

Descriptors: *Wastewater treatment, *Model studies, *MADAM, *Carbon, *Adsorption, Activated carbon, Cost analysis, Process design, Bioactivation, Biological treatment.

Adsorption processes using granular activated carbon have emerged as technically and economically viable means for advanced wastewater treatment and for removal of specific harmful organic chemicals. The technology of adsorption is relatively sophisticated, as it must be to address a problem of such scope and magnitude. Both performance and costs are dependent upon the efficiency of process design and operation. The most advanced approaches to the design and operation of carbon systems must be used to ensure efficient and cost effective applications. These, in turn, must be predicated on a sound understanding of the mechanisms and dynamics of adsorption processes, and of system variables which effect process performance. A number of significant concepts and considerations associated with the use of activated carbon for treatment of wastewaters have been identified and discussed in this paper. The properties of activated carbon, and the dynamics of adsorption processes are addressed in the context of selection of carbons and selection of reactor configurations. A predictive design model - MADAM - which synthesizes process dynamics and major system variables is outlined. Finally, the significant role of bioactivity in granular activated carbon systems and of synergistic use of powdered activated carbon in biological waste treatment systems are summarized. (See also W88-02284) (Lantz-PTT)
W88-02285

PRINCIPLES OF LIQUID-PHASE ADSORPTION,
ICI Americas, Inc., Wilmington, DE.
C. W. Broughton.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 29-66, 15 fig, 9 tab, 28 ref.

Descriptors: *Adsorption, *Wastewater treatment, *Carbon, Chemical properties, Chemical analysis, Pore structure, Activation, Hydrogen ion concentration, Molecular structure, Diffusivity, Oxidation-reduction potential.

Briefly reviewed are the effects of raw material and the activation process on pore structure, before considering the effects of functional groups on the carbon surface. In the past few years the literature has been growing concerning the functional groups on the carbon surface. While such functional groups definitely have bearing on adsorption their role can be overemphasized without taking into account the very important contribution of pore structure to adsorption. However, pore structure is an intrinsic part of the activation process itself as well as the nature of the starting raw material. Other important variables affecting adsorption as related to the adsorbate include solution pH, functionality, molecular size or weight, molecular branching, polarity, solubility, solvent, diffusion rate, competing solutes, and solution ionic strength. The oxidation-reduction potential of the carbon surface (quinoid structure) can also play a part, especially involving carbon as a catalyst. (See also W88-02284) (Lantz-PTT)
W88-02286

MASS TRANSFER CHARACTERISTICS OF ACTIVATED CARBON ADSORPTION,
Vanderbilt Univ., Nashville, TN.
J. A. Roth, and A. S. Kodavasal.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 67-94, 5 fig, 1 tab, 64 ref.

Descriptors: *Mass transfer, *Activated carbon, *Wastewater treatment, *Adsorption, *Model studies, Pores, Diffusivity, Carbon, Knudsen diffusion, Molecular structure, Fluidized bed process.

The basic concepts of mass transfer are applicable to the adsorption of pollutants in wastewater by activated carbon. The recommended model in this study includes an overall material balance, the assumption of an external liquid film mass transfer process, and pore diffusion in the carbon particles. The pore diffusion mechanism is complex, and can involve either or both liquid molecular diffusion in the pores, and Knudsen diffusion. The equilibrium is characterized by experimental isotherms, fit to models such as the Freundlich equation. The completely mixed, unsteady-state batch adsorber provides an experimental system for evaluating the effective diffusivity. The external mass transfer coefficient determined from this model correlates and is consistent with correlations for other diverse mass transfer processes in agitated vessels (completely mixed systems). The mass transfer coefficients are correlated as a function of the dimensionless power input parameter and the Schmidt number. The pore diffusion model, extended to the fixed bed and fluidized bed adsorber, incorporates the axial dispersion. This can be estimated from existing correlations or determined experimentally. Again, correlations of resulting external mass transfer liquid coefficients follow trends consistent with other diverse mass transfer systems. It must be recognized that these correlations each result in predictions within + or - 30 to 40%, and consequently, result only in estimates of breakthrough characteristics of adsorption. Furthermore, sophisticated computer modeling must be performed to predict simple one-solute-carbon systems. The utility of these models lies in the qualitative prediction of system behavior. (See also W88-02284) (Lantz-PTT)
W88-02287

EFFECT OF OPERATING PARAMETERS ON CARBON USAGE,
McMaster Univ., Hamilton (Ontario).
R. Narbaitz, and A. Benedek.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 95-107, 6 fig, 1 tab, 5 ref.

Descriptors: *Activated carbon, *Adsorption, *Carbon, *Model studies, *Wastewater treatment, *Process design, Optimization, Biological treatment, Biodegradation.

Granular activated carbon (GAC) contactors are an important wastewater treatment process for the removal of dissolved organics. In its design, the design engineer has to choose values of the pertinent design variables so as to optimize the cost of constructing and operating the process. Research at McMaster University has demonstrated that in the case of biodegradable wastewaters the biological activity within adsorbers can be treated as an add-on to the adsorptive removals. It also has shown that the purification of non-biodegradable wastewaters is purely due to adsorption. The mechanism stipulates the existence of two distinct types of adsorption rates. By one mechanism, adsorption is expected to occur relatively rapidly in pores where diffusion is unhindered, whereas very slow adsorption in sterically restricted or hindered pores is also expected to occur in parallel with the first mechanism. Peel and Benedek not only demonstrated this phenomena in a study involving adsorption isotherms, but also used it in the development of a predictive column model. This model can be calibrated solely from the results of batch isotherms and kinetics, and it was successfully calibrated and confirmed for several types of wastewaters. The model now permits the engineer to follow a proper operating line based design procedure as discussed in this paper. Various uses of this model to generate the desired operating lines are discussed. (See also W88-02284) (Lantz-PTT)
W88-02288

APPLICATION OF GAC TO MUNICIPAL WASTEWATERS,
ICI Americas, Inc., Wilmington, DE.
P. B. DeJohn, and R. W. Edwards.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 109-127, 2 tab, 18 ref.

Descriptors: *Wastewater treatment, *Municipal wastewater, *Activated carbon, Wastewater facilities, Design standards, Physical treatment, Chemical treatment, Dechlorination, Water quality, Tertiary wastewater treatment, Odor control, Carbon.

Thirty-two municipal wastewater plants using granular activated carbon have been designed and either started up or are under construction. These facilities are classified as physical chemical (13 total) tertiary (15 total) or dechlorination plants (4 total). This paper has concentrated on the problems encountered at physical chemical and tertiary plants and suggests several design modifications to alleviate these conditions for future plants. Most of the physical chemical facilities have shut down due to numerous operating problems. The major problems causing shutdown are underdrain failures and excessive odor generation. Additionally, many physical chemical plants fail to meet effluent quality standards because upstream processes fail to perform to expectations and influents have changed since the plant was designed. Tertiary facilities have been much more successful due to a lower organic loading onto the carbon and a stabilized biological influent to the carbon beds thereby lessening odor problems. Most of the problems encountered at tertiary facilities have been mechanical in nature. Mechanical problems also plague physical chemical plants. The major design criteria the authors suggest is to run extensive pilot studies to determine the efficacy of carbon and proper design parameter (contact time and carbon usage rate). The best means to control odor generation is to provide a stabilized waste to the carbon beds. Finally, a number of mechanical design features are suggested to overcome some of the problems encountered at existing facilities. (See also W88-02284) (Lantz-PTT)
W88-02289

APPLICATION OF GAC TO INDUSTRIAL WASTEWATERS,
QED Corp., Ann Arbor, MI.
F. E. Bernardin.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 129-149, 9 fig, 9 ref.

Descriptors: *Granular activated carbon, *Wastewater treatment, *Activated carbon, *Industrial wastewater, *Organic compounds, Load distribution, Linear velocity, Diffusers, Design standards, Chromatography, Adsorption, Desorption, Pilot plants.

Adsorption on granular activated carbon (GAC) is one of the best commercially proven methods for removing toxic organic chemicals from industrial wastestreams. It has demonstrated, in full-scale plants, a strong affinity for some of the best know toxic materials, such as DDT, PCB's, Dieldrin, Aldrin and many others. Furthermore, the technology and equipment for applying activated carbon in such a service are well proven and available. Over the past 15 years, adsorption treatment with activated carbon has been tested and installed for treatment of many wastewaters. Some commonly encountered isotherm plots and possible reasons for the shapes of the curves are presented. Design of a GAC pilot test seems obvious and straightforward at first pass. Among the parameters which should be considered in the physical design of a pilot GAC system are: surface loading (gpm/sq ft), linear velocity (ft/min), height to diameter ratio, and diffuser design. One of the most critical process design parameters to be gathered at the pilot level involves preferential adsorption of compounds which manifests itself in GAC applications by a chromatographic effect. This is critical where removal of selected organics is being accomplished in the presence of other adsorbable species. The chromatographic effect results in an effluent spike of concentration of individual components at higher levels than may have been applied to the GAC. The potential for chromatographic effects is present in all complex industrial wastewater containing mixtures of organic materials and should be looked for in pilot scale since this can have great impact on carbon usage rate in the full scale system. Operating variables in the process portion of the industrial plant can affect the adsorption system if wide fluctuations in concentration or ratio of the wastewater components occur. While GAC is much less prone to upsets due to shock loads than biological treatment systems, desorption and wave front disruptions can occur. As with all wastewater treatment processes, a constant influent flow and concentration produce best results, so any raw waste equalization attainable is advantageous. (See also W88-02284) (Lantz-PTT)
W88-02290

REMOVAL OF TOXIC OR PRIORITY POLLUTANTS FROM PROCESS WASTEWATER BY GAC,
Environmental Science and Engineering, Inc., Gainesville, FL.
L. J. Bilello.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 151-174, 12 fig, 6 tab.

Descriptors: *Granular activated carbon, *Wastewater treatment, *Activated carbon, Priorities, Process wastewater, Adsorption, Carbon, Cost analysis, Organic compounds, Steam stripping.

Granular activated carbon (GAC) can be used effectively to remove priority pollutants from process waste streams to concentrations below analytical detection limits (typically 10 micrograms/L). The use of GAC on the process waste streams rather than a combined or final wastewater is more efficient because of the reduced waste stream flow, a higher concentration of the component, less competition for adsorption sites, and more reliable control of the effluent discharge. Removal of priority pollutants by GAC can be part of an overall system treating a given process waste stream. Technologies such as stream stripping can be used before the carbon system to reduce the overall cost of treatment and still ensure meeting of low level effluent requirements. Competitive adsorption for these pilot plant studies was as significant as the concentration of the least adsorbable priority pollutant in affecting carbon usage rates. The presence of other more adsorbable organics does, however, cause the less adsorbable component to strip off, with effluent concentration from a carbon column for that component exceeding the influent concentration. This requires close monitoring of carbon effluent for a complex waste stream. Use of series or staged configuration of a carbon system will provide protection for a rapid breakthrough, thus protecting downstream treatment systems and preventing the appearance of a priority pollutant in the effluent above allowable levels. (See also W88-02284) (Lantz-PTT)
W88-02291

PRETREATMENT OF INDUSTRIAL WASTES WITH GAC FOR REMOVAL OF PRIORITY POLLUTANTS,
Michigan Univ., Ann Arbor.
W. J. Weber.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 175-195, 4 fig, 4 tab, 44 ref.

Descriptors: *Granular activated carbon, *Wastewater treatment, *Industrial wastes, *Activated carbon, Pretreatment of wastewater, Organic compounds, Raw wastewater, Municipal wastewater, Adsorption, Carbon, Mathematical models, Cost analysis.

The treatment of industrial wastes for removal of 'priority pollutants' is perhaps the most significant and challenging wastewater application for activat-

ed carbon today. Few industrial operations produce raw waste streams which are completely free of one or more of the compounds currently assigned to the EPA priority list. This will be more the case as the list is expanded in the future. In cases of industrial discharge to municipal systems, it is usually only the priority pollutants which are specifically prohibited; others can usually be accomodated by the municipal treatment system, and the discharger assessed an appropriate users fee. In such instances, a granular activated carbon (GAC) system frequently can function, with certain ancillary support operations, as a singular pretreatment scheme. This is particularly true where problem waste streams can be identified and isolated from the main industrial flow, a not uncommon situation. Examples of differences and trends in adsorption capacities and rates of representative priority pollutants are given, and the effects of typical variables such as carbon type and background waste composition illustrated. Finally, the application and usefulness of mathematical modeling techniques for more efficient and cost-effective design of adsorbers for priority pollutant removal have been demonstrated. (See also W88-02284) (Lantz-PTT)
W88-02292

SOURCE TREATMENT OF INDUSTRIAL WASTEWATER WITH GRANULAR ACTIVATED CARBON,
Rubel and Hager, Inc., Tucson, AZ.
D. G. Hager.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 197-210, 10 fig, 5 ref.

Descriptors: *Wastewater treatment, *Granular activated carbon, *Industrial wastewater, *Activated carbon, Organic compounds, Water quality, Wastewater facilities, Regulations, Carcinogens, Water pollution sources, Adsorption, Pollution load, Fluidized bed, Municipal water.

Installation of a granular activated carbon (GAC) wastewater treatment system at Lake Tahoe some fifteen years ago marked the first large scale municipal application for the adsorption process. Following the Lake Tahoe installation, many municipal and industrial waste treatment facilities were installed with the common objective of reducing residual dissolved organic contaminants which have survived conventional biological treatment. The GAC System was placed at the end of the treatment sequence and the organics being removed were measured in terms of biological oxygen demand (BOD), chemical oxygen demand (COC), total organic carbon (TOC) and/or soluble (organic) oxygen demand (SOC). More recently, industrial GAC systems have been designed to remove specific chemical contaminants rather than overall general organic reductions. Current regulatory actions emphasize the removal of specific organic contaminants from industrial effluents which are considered to be toxic and/or carcinogenic. For removal of specific organic contaminants the adsorptive capacity of activated carbon is more fully utilized in point of source treatment where specific contaminant concentrations are highest and other organic concentrations are lowest. Point of source GAC treatment provides an opportunity for recovery of valuable products from the wastewater via non-thermal regeneration of the GAC. Countercurrent adsorption systems, such as pulsed bed adsorbers, maximize the loading of contaminants on the GAC in each adsorption cycle and thereby reduce the quantity of carbon exhausted per gallon of treated water. Recently, developed fluid bed carbon reactivation technology has appreciably reduced fuel consumption and improved reactivated carbon quality in both industrial and municipal GAC water applications. (See also W88-02284) (Lantz-PTT)
W88-02293

TREATMENT OF PRIORITY POLLUTANTS WITH RESINS,
Illinois Inst. of Tech., Chicago.
J. W. Patterson, and R. Patzelt.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 211-245, 9 fig, 11 tab, 26 ref.

Descriptors: *Resins, *Wastewater treatment, *Organic compounds, Hydrocarbons, Phenols, Aromatic compounds, Adsorption, Carbon, Polymers, Chemical reactions, XAD-4, L-863, XAD-340, Styrene-divinylbenzene, Molecular structure.

Certain compounds including chlorinated hydrocarbons, aromatic amines, and phenols are resistant to carbon adsorption. Most of these organic compounds are small molecules, with low molecular weights and polar characteristics. Macroreticular resins (polymeric adsorbents) offer an alternative to activated carbon in wastewater treatment. These porous styrene-divinylbenzene resins have no functional ion exchange sites, and function only by adsorption, which occurs via relatively weak Van der Waal's binding forces. Under identical adsorptive conditions, the resin XAD-4 has proven to be the most effective adsorbent of all the polymers tested here. L-863 and XAD-340 were also effective adsorbents, with XAD-340 showing a higher affinity than XAD-4 for toluene, benzene, and phenol. In the adsorption of low molecular weight aromatic compounds from aqueous solutions by polymeric resins, the area of the adsorbent and the functional groups on the surface of the adsorbent are important parameters in determining both the intensity of adsorption and the adsorptive capacity. The change in entropy is the main driving force in the physical adsorption of the studied hydrocarbons from aqueous solution. Adsorption of the studied compounds was found to conform to the Freundlich model, although results of these experiments apply to only single solute systems using distilled water as the solvent. Systems of mixed solutes could change the isotherm and breakthrough curve parameters. (See also W88-02284) (Lantz-PTT)
W88-02294

PRACTICAL APPLICATION OF ADSORBENT RESINS,
AWARE, Inc., Nashville, TN.
S. E. Shelby, and C. E. Adams.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 247-272, 11 fig, 4 tab.

Descriptors: *Resins, *Adsorption, *Pesticides, *Wastewater treatment, Hexachlorocyclopentadiene, Pretreatment of wastewaters, Activated carbon, Molecular structure, XAD-4, Suspended solids, Organic compounds.

Two chemicals, the pesticide endrin, the use of which has been recently banned in the United States by the EPA, and a chemical used in the production of endrin and other chlorinated pesticides, hexachlorocyclopentadiene or hex, have received widespread public broadcast. These and other pesticides and organic chemicals are manufactured at the Velsicol Chemical Corporation plant in Memphis, Tennessee. This paper presents the findings of an experimental program conducted to develop the best available treatment process technology required for treatment of the Velsicol plant process wastestream. In development of best available treatment technology for this wastewater it was determined that selection of the system for removal of organics would be most critical in determining treatment effectiveness. Therefore, both macroreticular resins and granular activated carbon adsorption were evaluated to define performance levels and develop design parameters. Pretreatment requirements were determined for the waste and included equalization, pH control, and suspended solids removal ahead of the adsorption system. Regeneration of both resin and carbon systems were evaluated within the time available. After pretreatment for suspended solids removal, the concentration of contaminants was generally less than the reported solubility limit of the compound. In pretreatment of the waste, greater than 90% removal of many compounds was achieved. Some conclusion and observations drawn from runs in which resin and carbon were employed in parallel systems are: (1) Breakthrough of the low molecular weight (MW) substances in the waste occurred after relatively short run times using both regenerated carbon and resin; (2) Relatively high removal of other substances monitored during this investigation (Hex, Hex BCH, Hex VCL/Octa, heptachlor, aldrin, isodrin, heptachlor epoxide, chlordane, dieldrin and endrin) were observed for 3,000 BV of throughput with the exception of chlordene; (3) Except for the very low MW substances, sharp breakthroughs of individual organics were not observed; and (4) Virtually identical exhaustion performance was observed for both the regenerated activated carbon and the XAD-4 systems. (See also W88-02284) (Lantz-PTT)
W88-02295

SYNTHETIC ADSORBENTS IN WASTEWATER TREATMENT,
Michigan Univ., Ann Arbor.
B. M. Vliet, and W. J. Weber.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 273-283, 1 fig, 1 tab, 27 ref.

Descriptors: *Adsorption, *Synthetic adsorbents, *Wastewater treatment, Polymers, Carbonaceous adsorbents, Performance evaluation, Water quality control.

The principal focus of this paper relates to the use of polymers which contain no appreciable quantities of ion-exchange groups, and which act as adsorbents rather than exchange resins. Various types of synthetic adsorbents are commercially available in the form of beads or granules, and are characterized according to polymer matrix, pore structure and the presence of any functional groups. The synthetic adsorbents, containing no ion exchange functional groups, are designated polymeric adsorbents. Carbonaceous adsorbents are a recent addition to the inventory of synthetic adsorbents. These materials are manufacture by partial pyrolysis of appropriate beaded polymer matrices, yielding black spherical particles, whose chemical composition is intermediate between that of activated carbon and the polymeric adsorbent base-materials. Owing to the diverse performance and quality requirements of wastewater adsorption systems, it is not possible to designate a universally efficacious adsorbent: selection of an optimum adsorbent for a given application is very dependent on the relevant circumstances and requirements. Although activated carbons and synthetic polymeric adsorbents have been effectively applied in many wastewater treatment processes, the synthetic polymeric adsorbents have demonstrated particular usefulness in the context of pollution abatement coupled with adsorbate recovery. (See also W88-02284) (Lantz-PTT)
W88-02296

INFLUENCE OF BIOLOGICAL ACTIVITY ON GAC PERFORMANCE,
Massachusetts Univ., Amherst.
F. A. DiGiano.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 285-305, 9 fig, 1 tab, 22 ref.

Descriptors: *Microbiological studies, *Wastewater treatment, *Activated carbon, *Performance evaluation, Organic compounds, Chemical oxygen demand, Biodegradation, Trace organics, Particle size, Wastewater pretreatment, Adsorption.

Microbial activity on granular activated carbon (GAC) is to be expected in wastewater treatment. There is ample evidence to show that GAC beds remove organic compounds over periods that far exceed the service time based on adsorption capacity alone. Roughly 20-30% removal of COD can be attributed to the biodegradation process in

steady-state operation. There is even some evidence to suggest that removal of trace organic compounds occurs by this mechanism. Aspects of the process design, however, remain ill-defined. For example, there is little information available to guide in selection of: pretreatment; GAC bed contact time; GAC particle size distribution; application rate; frequency of backwash; and frequency of regeneration. There is also a need to identify the compounds which may be removed by biodegradation and to explain the role, if any, of sorption site removal as a consequence of the process. (See also W88-02284) (Lantz-PTT)
W88-02297

BIOLOGICAL TREATMENT WITH GRANULAR ACTIVATED CARBON,
Utah Univ., Salt Lake City.
H. D. Stensel, and J. P. Leglise.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 307-319, 4 fig, 2 tab, 11 ref.

Descriptors: *Activated carbon, *Granular activated carbon, *Biological treatment, *Wastewater treatment, Biological oxygen demand, Chemical oxygen demand, Domestic water, Municipal wastewater, Secondary wastewater treatment, Tertiary wastewater treatment, Clarification.

For normal domestic wastewater treatment applications, the use of granular activated carbon in the biological aerated filter is not justified on a cost and performance basis. It appears that using an activated carbon media in the system result in improved COD removal for more difficult to degrade wastewaters. Previous observations indicate that granular activated carbon (GAC) would be desired in such systems when improved COD removal is desired or removal of toxic pollutants is necessary. Further work is necessary to determine the conditions that result in improved biological acclimation in biological GAC systems. The biological aerated filter presented is a potentially attractive alternative to present secondary treatment systems for the following reasons: (1) An advanced secondary or tertiary quality effluent can be achieved. Effluent suspended solids and BOD5 concentrations were less than 5 mg/L and 10 mg/L respectively for BOD loadings that were about one-fifth of that used in conventional activated sludge systems; (2) No secondary clarifier is required. This not only reduces the cost of the wastewater facility, but eliminates a potential operating cause for poor effluent quality when poor sludge characteristics exist; (3) The system can be used for plant upgrading and its small land area requirement is attractive; and (4) Anaerobic digestion of the solids produced in the system in domestic applications can produce methane gas to drive the blowers to supply air to the biological aerated filter. (See also W88-02284) (Lantz-PTT)
W88-02298

THERMAL REACTIVATION OF GRANULAR ACTIVATED CARBON,
Calgon Corp., Pittsburgh, PA.
W. G. Schuliger.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 321-335, 2 fig, 1 tab, 9 ref.

Descriptors: *Wastewater treatment, *Adsorption, *Thermal reactivation, *Activated carbon, *Granular activated carbon, Economic aspects, Energy, Costs, Maintenance, Performance evaluation, Equipment.

When an adsorption system using granular activated carbon (GAC) is being considered to treat a water or wastewater stream, one of the first questions to be asked is, whether it is economical to reactivate the carbon. For the majority of systems the answer is yes. Then, if it is decided to reactivate on-site instead of using a reactivation service a series of points should be addressed. These are: (1) current state-of-the-art systems; (2) type of equipment to be purchased; (3) activity of the reactivated carbon and its operating parameters; (4) potential losses; (5) energy requirements and their effects; (6) environmental implications; (7) capital and operating costs; and (8) maintenance problems. This paper aims to provide information which accurately addresses each point as it relates to thermal reactivation of granular activated carbon. (See also W88-02284) (Lantz-PTT)
W88-02299

METHODOLOGY OF INDUSTRIAL WASTEWATER PAC EVALUATIONS,
ERM-Southeast, Inc., Brentwood, TN.
B. P. Flynn.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 337-356, 4 fig, 6 tab, 4 ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Performance evaluation, *PACT process, *Activated carbon, Activated sludge, Pilot plants, Municipal wastewater.

A methodology is presented for evaluating PACT (the addition of powdered activated carbon to the activated sludge process) in the industrial wastewater treatment environment at the following stages: (1) Problem definition; (2) Preliminary testing; (3) Lab scale evaluation; (4) Pilot scale evaluation; and (5) Full scale evaluation. Many of the techniques detailed in this paper are applicable to municipal waste treatment problems as well. In addition, the methodology outlined here should be considered as a guide, as individual circumstances can require significant modifications to these techniques. It should be emphasized that an evaluation of the PACT process should be a part of a well thought out, comprehensive plan of evaluation aimed at solving a well defined wastewater treatment problem. As such, application of good evaluation techniques are a misdirected effort if aimed at the wrong problem. (See also W88-02284) (Lantz-PTT)
W88-02300

APPLICATION OF PACT(R) TO MUNICIPAL WASTEWATERS,
Zimpro, Inc., Rothschild, WI.
J. A. Meidl.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 357-383, 7 fig, 14 tab, 28 ref.

Descriptors: *PACT process, *Wastewater treatment, *Municipal wastewater, *Activated carbon, *Powdered activated carbon, Biological treatment, Physical treatment, Activated sludge, Aeration, Water quality, Odor control.

From the inefficient physical-chemical treatment process has come the highly efficient biophysical treatment process 'PACT'. By adding powdered carbon (PAC) to the aeration tank of an activated sludge system (PACT), stable treatment and high quality product water result. With PAC in the aerator, favorable impact is found in settling, oxygen transfer, disinfection, and even total plant odor control. When wet air regeneration is used in conjunction with PACT, the resultant system is cost competitive with activated sludge technology. PACT - wet air regeneration, though classified as an innovative technology, is not new. The technology has been fully tested and developed - the first full scale system operated in 1971. Since that time projects in sizes ranging from 0.25 MGD to 54 MGD are under contract. (See also W88-02284) (Lantz-PTT)
W88-02301

APPLICATION OF PACT(R) TO INDUSTRIAL WASTEWATERS,
Oklahoma State Univ., Stillwater.
D. F. Kincannon.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 385-400, 6 fig, 6 tab, 7 ref. EPA Research Grant R0805242-010.

Descriptors: *Wastewater treatment, *PACT process, *Industrial wastewater, *Powdered activated carbon, *Activated carbon, Carbon, Organic compounds, Pollution load, Activated sludge, Heavy metals, Suspended solids, Biological treatment.

The PACT (powdered activated carbon (PAC) to the activated sludge process) is a viable alternative for treating industrial wastewaters. The treatment efficiency is a function of carbon dosage and the sludge age (in days) that the reactor is operated. The process is very effective in removing organic priority pollutants. Organic priority pollutants tend to leak from activated sludge reactors during shock loads; however, this does not occur with the PACT process. The process is only moderately successful in removing heavy metals. Sludge settleability is improved by powdered carbon. One major question still needs to be answered - whether sludge age can be properly controlled in the PACT system. Because of the powdered carbon it is difficult to determine the concentration of biological solids present in the PACT activated sludge. Solutions to this problem need to be found. (See also W88-02284) (Lantz-PTT)
W88-02302

APPLICATION OF COMBINED POWDERED CARBON/ACTIVATED SLUDGE TREATMENT TO LURGI PROCESS COAL GASIFICATION WASTEWATERS,
Engineering-Science, Inc., Austin, TX.
F. J. Castaldi.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 401-434, 7 fig, 12 tab, 13 ref.

Descriptors: *Carbon, *Activated sludge, *Lurgi process, *Wastewater treatment, *Industrial wastewater, Gasification, Coal gasification, Economic aspects, Energy, Biological treatment, Biodegradation.

The primary advantage of the energy produced from a synthetic fuel over that associated with the direct use of coal is the transfer of environmental problems from the often small, individual end users to the large, commercial-scale conversion facility. This promise has spurred the development of numerous processes for the production of synthetic fuels from coal. The Lurgi Dry Ash process best represents current state-of-the-art commercial fixed-bed gasifier technology. It is the only commercial process operating at high pressures, usually between 24 and 31 atmospheres. Temperatures within the gasifier are about 1200 to 1500 F at the middle of the bed and about 1800 to 2500 F at the bottom. At higher temperatures at the bottom of the gasifier (greater than 2500 F), the coal ash is melted to form a liquid slag. Lurgi gas liquors are generally high in phenols, tars, oils, ammonia, biochemical oxygen demand (BOD), and chemical oxygen demand (COD). These gas liquors have a strong potential for environmental pollution due to a high content of biodegradable substances. This detrimental effect is increased by the fact that the phenol, ammonia compounds, phenolic compounds, and dissolved tar components represent substances which are toxic in the environment. A reduction in the quantity of biodegradable substances, and the complete elimination of the toxicity associated with these wastewaters are the basic demands of any gas liquor treatment system. The pretreatment of these gas liquors, nd further biodegradation via biological oxidation, powdered carbon and/or activated sludge systems are discussed in detail, as well as the cost and energy requirements for these systems. (See also W88-02284) (Lantz-PTT)
W88-02303

PRIORITY POLLUTANT REMOVAL: COMPARISON OF THE DUPONT PACT(R) PROC-

ESS WITH ACTIVATED SLUDGE FOLLOWED BY GRANULAR CARBON COLUMNS,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
D. G. Hutton.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 435-472, 22 fig, 11 tab, 3 ref.

Descriptors: *Organic compounds, *Activated sludge, *PACT process, *Carbon, *Powdered activated carbon, *Wastewater treatment, Industrial wastewater, Organic carbon, Chromatography, Chemical analysis, Color, Aromatic compounds, Naphthalene, Activated carbon.

This extensive laboratory study of the treatability of a variable, multicomponent wastewater showed the activated sludge process produced > 85% removal for 23 of the 36 compounds found in the feed to the DuPont Chambers Works, a chemical manufacturing site. Adding powdered carbon at 100 ppm dosage to the activated sludge process (DuPont PACT process) increased performance so that >85% removal was achieved for 30 of the 36 compounds. Granular carbon treatment of the activated sludge effluent from such a complex and changing mixture was exactly as expected in terms of general parameters like color and soluble TOC. However, for specific compounds this was not the case. Of the 36 priority pollutants fed, only 14 gave classical breakthrough curves in the carbon columns. The significance of this depends on the future regulations for these compounds, but does constitute a significant problem in the performance of granular carbon columns. At the point of TOC and color breakthrough (point where limits could not be made for five straight days) the first carbon column was doing moderately well. The average removal was 50% for 17 of the 36 compounds and 85% for 11 compounds. Aromatic compounds, particularly naphthalene, were found in the carbon column effluents, even though they were never detected in the feed. The carbon was more effectively used by the PACT process than the carbon columns. At the point of color and soluble TOC breakthrough (they occurred together) the carbon columns had expended a dosage of 140 ppm. The PACT process was achieving color and soluble TOC goals at the carbon dosage of 100 ppm used. Breakthrough of the first compound in carbon column 1 at the equivalent carbon dosage of 33 ppm. Approximately 11,000 GC/MS analytical data points were generated in this study. The actual study required three months to generate the samples and 10 months to complete the analyses. (See also W88-02284) (Lantz-PTT)
W88-02304

BIOLOGICAL/ADSORPTION INTERACTIONS WITH PAC,
Vanderbilt Univ., Nashville, TN.
W. W. Eckenfelder, H. Fuentes, and J. H. Orozo-Garcia.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 473-481, 3 fig, 7 ref.

Descriptors: *Adsorption, *Biological treatment, *Powdered activated carbon, *PAC, *Activated carbon, *Model studies, Organic compounds, Carbon, PACT process, Activated sludge process, Flocculation, Biooxidation, Biological studies.

The addition of powdered activated carbon (PAC) to an aeration basin results in higher organic removal, improved solids settling and sludge handling, greater resistance to toxic and/or shock loading and more stable effluents in cases of variable organic and/or hydraulic loads. The organic removal rate in the activated sludge process is enhanced by the addition of PAC by the direct adsorption of degradable organics and by increasing the contact time of refractory organics with the biomass adsorbed to the carbon. Non-degradable organics are also removed by the carbon. In the PACT (the addition of PAC to the activated sludge process) process a number of reactions are occurring concurrently indicating biooxidation of soluble organics in the wastewater, adsorption of organics on the carbon, adsorption on the biological flocs and biooxidation of degradable organics on the carbon. There is some question as to whether the biooxidation rate itself is enhanced in the presence of carbon. Data is not available at present to clearly delineate these various reactions. A conceptual model has been presented in this paper which lumps the effects of biooxidation, adsorption and bioregeneration. It is anticipated that as more data is reported that the model can be modified and refined. (See also W88-02284) (Lantz-PTT)
W88-02305

IMPROVED NITRIFICATION WITH THE PACT(R) PROCESS,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
G. F. Dunn, D. G. Hutton, and C. L. Berndt.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 483-507, 7 fig, 12 tab, 13 ref.

Descriptors: *Nitrification, *PACT process, *Wastewater treatment, *Powdered activated carbon, Activated carbon, Activated sludge, Ammonia, Nitrogen, Temperature, Industrial wastewater, Municipal wastewater, Dissolved oxygen, Hydraulic detention time, Solids retention time, Activated carbon.

PACT, the combination of powdered activated carbon and activated sludge, has been shown to be extremely effective in biologically nitrifying ammonia nitrogen in both domestic and industrial wastes. When PACT was compared to activated sludge, PACT consistently provided improved nitrification. When low temperatures were encountered, PACT often was the only process to remove ammonia effectively. To nitrify domestic and combined domestic and industrial wastewaters, the PACT process generally requires an SRT ranging from 7 to 15 days and a hydraulic detention period of 3.0 to 6.0 hours. At sustained wastewater temperatures of 10 C to 25 C, the effect of temperature on system design is minimal. At temperatures of 5 C to 8 C, the effect of temperature on the design SRT and hydraulic detention time must be considered. PACT will nitrify industrial wastes, but longer SRT and hydraulic detention periods than for domestic wastewaters are generally needed. The actual design conditions will vary depending on the industrial waste to be treated. In comparison with activated sludge nitrification processes, PACT operates at lower hydraulic detention times and provides increased reliability of treatment, increased nitrification efficiency, superior low temperature performance and reduced sensitivity to periods of low dissolved oxygen. (See also W88-02284) (Lantz-PTT)
W88-02306

NITROGEN AND CONTAMINANT CONTROL OF COKE PLANT EFFLUENTS IN AN UPGRADED BIOLOGICAL SYSTEM,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5G.
W88-02307

THERMAL REGENERATION OF PACT(R) PROCESS POWDERED ACTIVATED CARBON,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
D. G. Hutton, and H. W. Heath.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 529-550, 10 fig, 1 tab, 3 ref.

Descriptors: *Thermal regeneration, *Activated carbon, PACT process, *Powdered activated carbon, Costs, Temperature, Activated sludge, Sludge disposal, Economical aspects, Carbon.

High temperature thermal methods can be used for regenerating powdered activated carbon from PACT (powdered activated carbon (PAC) to the activated sludge process) sludge. Powdered carbon from PACT process sludge can be regenerated in a variety of ways. DuPont's Chambers Works regenerated over nine million pounds of carbon between 1977 and 1979 in a multiple hearth furnace, all with satisfactory quality. The advantages of regenerating spent PACT carbon are two-fold: (1) elimination of sludge disposal problems; and (2) recovering the economic value of the carbon. Generally, a treatment plant must be about 10 mgd or larger to justify the investment for a carbon regeneration facility based on the recovery of carbon value alone. However, sludge disposal costs must also be considered when making this decision. Because of the Resource Conservation and Recovery Act regulations and other considerations, sludge disposal costs must continue to increase. This makes the regeneration of carbon more attractive. When sludge disposal or incineration costs are considered carbon regeneration may become economically attractive for plants as small as 1 mgd. (See also W88-02284) (Lantz-PTT)
W88-02308

WET AIR REGENERATION OF PAC,
Zimpro, Inc., Rothschild, WI.
C. L. Berndt.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 551-569, 6 fig, 8 tab, 7 ref.

Descriptors: *Wet air regeneration, *Powdered activated carbon, *Wastewater treatment, *Activated carbon, Costs, Economic aspects, Carbon, Energy, PACT process, Biological treatment, Performance evaluation.

The Wet Regeneration process is discussed and typical performance and cost information is presented. This technology is applicable to spent carbon regeneration for potable water treatment, physical-chemical and PACT wastewater treatment situations. Advantages of Wet Air Regeneration include no need for spent carbon slurry dewatering prior to regeneration, low fuel requirements, simple operation and control, and economical operating cost. When applied to PACT treatment, both spent carbon regeneration and biological solids disposal are accomplished simultaneously. Performance of Wet Air Regeneration in terms of regenerated carbon quality was shown to be effective. Performance of the PACT/Wet Air Regeneration systems at Vernon, CT and Kimitsu, Japan are excellent confirming the applicability of Wet Air Regeneration to successful PACT treatment. (See also W88-02284) (Lantz-PTT)
W88-02309

ECONOMICS OF ADSORPTION IN WASTEWATER TREATMENT,
Engineering-Science, Inc., Austin, TX.
D. L. Ford, and J. G. Monson.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 571-593, 10 fig, 3 tab, 10 ref.

Descriptors: *Economic aspects, *Wastewater treatment, *Adsorption, Biological treatment, Activated carbon, Cost analysis, Rotating bed contactors, Biological oxygen demand, Denitrification, Activated sludge, PACT process, Cost-benefit analysis.

The economics of biological treatment incorporating activated carbon are presented. Although it is not possible to present all of the input information used in this cost analysis, the major economic factors and assumptions are cited. Using universally accepted design criteria, the various wastewater treatment alternatives are sized, the capital costs estimated, the operation and maintenance costs predicted, and these cost components brought to a present worth basis in order to provide a direct economic comparison. It should be reiterated that this is not the only factor which leads to final

process selection but it does provide a basis for assessing the cost-effectiveness of each of the treatment systems. Inherently, high-rate biological systems such as the RBC and activated sludge processes are more cost-effective (on a BOD removal basis) and less energy intensive than hybrid biological-carbon systems. However, when ultimate solids disposal including incineration is required, the economic differential between a non-nitrifying RBC or activated sludge system, and the PACT system becomes less pronounced. When nitrification is required, the PACT system may be more cost-effective than activated sludge. Moreover, the PACT system may be the level of technology required to attain the effluent quality requirements in terms of potentially toxic organics as established by the regulatory authority. This decision, of course, will be made on the merits of each particular treatment facility and corresponding level of effluent quality required. In summary, it is recommended that each treatment system alternative being considered for a particular location be carefully evaluated in terms of process effectiveness, process reliability, associated capital costs, operation and maintenance costs, and energy requirements before finalizing process selection. (See also W88-02284) (Lantz-PTT)
W88-02310

COMPARISON OF POWDERED AND GRANULAR CARBON ECONOMICS IN WASTEWATER TREATMENT,
J. E. McCormick.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 595-615, 11 fig, 19 tab, 7 ref.

Descriptors: *Wastewater treatment, *Economic aspects, *Powdered carbon, *Granular carbon, *Activated carbon, Industrial wastewater, Tertiary wastewater treatment, Activated sludge, Aeration, PACT process, Cost analysis, Comparison studies.

After a decision to use activated carbon to treat an industrial wastewater stream is made, the next most frequently asked question is whether to use granular or powdered carbon. This paper describes hypothetical cases in which costs for GAC with multi-hearth regeneration are compared to PAC (powdered activated carbon) with wet air regeneration (WAR) and PAC on a throwaway basis. System costs for treating industrial wastewater flows from 1 to 25 MGD are presented. For this comparison, granular activated carbon (GAC) is used in a tertiary mode to polish activated sludge effluent while PAC is added directly to the activated sludge aeration basin (PACT process). The following conclusions can be made concerning operation and maintenance (O and M) costs during depreciation: (1) All powdered carbon systems are more economical to operate up to a plant flow of 8 MGD. After this, GAC is less expensive than only one PAC system - PAC on a throwaway basis at the highest maintenance dosage, 135 ppm; and (2) PAC on a throwaway basis is the most economical method of using activated carbon up to a flow of about 4 mgd. After this PAC wet air regeneration is more economical. The following conclusions can be made concerning O and M costs, after depreciation: (1) PAC wet air regeneration is the most economical method of using activated carbon; (2) PAC on a throwaway basis at the lowest maintenance dosage is more economical than GAC at all flows studied; and (3) PAC on a throwaway basis at the highest maintenance dosage is the most expensive form of carbon treatment except for a plant flow of 1 mgd. At 1 mgd GAC costs are slightly greater than PAC. Other observations concerning PAC on a throwaway basis are: (1) It is the most economical system to install since only storage and feeding equipment are needed; (2) It is the most economical way to use activated carbon when it is not required on a continuous basis; and (3) PAC on a throwaway basis should increase the dewaterability of waste sludge. (See also W88-02284) (Lantz-PTT)
W88-02311

GROUNDWATER TREATMENT TECHNOLOGY,
DETOX, Inc., Dayton, OH.
For primary bibliographic entry see Field 5G.
W88-02322

MANAGEMENT OF HAZARDOUS WASTE: TREATMENT/STORAGE/DISPOSAL FACILITIES,
J. R. Cashman.
Technomic Publishing Co., Inc., Lancaster, PA. 1986. 311 p.

Descriptors: *Wastewater treatment, *Waste disposal, *Waste storage, *Hazardous wastes, *Toxic wastes, *Waste management, Wastewater facilities, Regulations, Legal aspects, Technology.

The 1984 amendments to the Resource Conservation and Recovery Act (RCRA) that were signed into law on November 8, 1984, drastically increase the number of hazardous waste generators that must comply with components of RCRA by bringing under regulation for the first time an estimated 100,000 to 130,000 'small quantity generators;' those firms generating between 100 and 1,000 kilograms (220 to 2200 pounds) of hazardous waste per month. Extending RCRA coverage to small quantity generators means a drastic increase in the number of companies that may eventually have to locate and evaluate TSD (Treatment/Storage/Disposal) services and facilities. The average observer has been left to wonder to what extent current hazardous waste management is a bucket-and-mop operation, and to what extent it is a business requiring extensive capital and equipment. This book does not seek to compete with technical coverage of hazardous waste management practices, nor does it attempt to cover state-of-the-art technology planned for the future that may or may not ever get off the drawing board. The orientation here is tools, equipment, materials, practices, procedures, and methods used on a day-to-day basis by a limited number of representative TSD facilities. Firms and/or facilities were visited where the authors could observe operations. This book uses these visits to provide hazardous waste generators with a realistic and, hopefully, objective view of representative TSD facilities. (Lantz-PTT)
W88-02325

SLOW SAND FILTRATION AS A TECHNIQUE FOR THE TERTIARY TREATMENT OF MUNICIPAL SEWAGES,
Loughborough Univ. of Technology (England). Dept. of Civil Engineering.
K. V. Ellis.
Water Research WATRAG, Vol. 21, No. 4, p 403-410, April 1987. 3 tab, 25 ref.

Descriptors: *Slow sand filtration, *Wastewater treatment, *Tertiary wastewater treatment, *Effluents, Performance evaluation, Filtration, Wastewater.

Slow sand filtration was studied for tertiary treatment of secondary effluents derived from conventional aerobic, biological treatment processes operating with municipal wastewaters. Secondary effluents derived from both an activated-sludge plant and from a percolating filtration plant were employed. The basic slow sand filtration unit used consisted of a 140 mm i.d. perspex cylinder, 2.65 m in height containing a 950 mm depth of fine sand. Treatment rates were either 3.5 or 7.0 m/d and the sand used was of an effective size initially of 0.3 mm and then later of 0.6 mm. This investigation has demonstrated that a laboratory-scale slow sand filtration unit is capable of consistently removing at least 90% of the suspended solids, more than 65% of the remaining BOD and over 95% of the coliform organisms from the settled effluent from an operational percolating filter plant. The length of operational run averaged 20 days at 3.5 m/d and 13 days at 7.0 m/d. Slightly inferior results were achieved when using the settled effluent from an operational activated sludge unit. Further investigation employing a horizontal-flow gravel prefilter demonstrated that at flows of 2 m/h with a contact time of 33 min up to 82% of the suspended solids in the secondary effluent could be removed prior even to slow sand filtration. (Author's abstract)
W88-02338

FLUIDIZATION AND REACTOR BIOMASS CHARACTERISTICS OF THE DENITRIFICATION FLUIDIZED BED BIOFILM REACTOR,
Westvaco Corp., Covington, VA. Bleached Board Div.
L. T. Mulcahy, and W. K. Shieh.
Water Research WATRAG, Vol. 21, No. 4, p 451-458, April 1987. 6 fig, 4 tab, 19 ref.

Descriptors: *Wastewater treatment, *Biomass, *Denitrification, *Reactors, *Biofilms, *Fluidized beds, Prediction, Equations, Engineering.

The fluidization and reactor biomass characteristics of the denitrification fluidized bed biofilm reactor (FBBR) were investigated. Experimental evidence obtained indicates that Richardson-Zaki correlation, which was developed for rigid solid particles, provides an excellent description of the fluidization mechanics of a denitrification FBBR. However, correlations for calculations that the degree of bed expansion increases with increased bioparticle size (i.e. increased biofilm thickness). The fluidization and reactor biomass correlations developed in this investigation are capable of providing a direct and accurate prediction of biomass concentration and bed expansion in FBBRs designed for wastewater treatment applications. Engineering applications of these correlations are discussed. (Author's abstract)
W88-02344

SEASONAL SPECIES COMPOSITION, DENSITY AND ROLE OF NEMATODES IN ACTIVATED-SLUDGE EFFLUENT TREATMENT WORKS,
Lancaster Univ. (England). Dept. of Biological Sciences.
M. Woombs, and J. Laybourn-Parry.
Water Research WATRAG, Vol. 21, No. 4, p 459-467, April 1987. 8 fig, 2 tab, 43 ref.

Descriptors: *Temporal variation, *Nematodes, *Activated sludge, *Wastewater treatment, Effluents, Temperature, Wastewater, Species composition.

The species composition, seasonal distribution and role of the nematode communities in two oxidation ditch activated-sludge effluent treatment works in Cumbria, U.K. were investigated for a 12 month period (1982/83). The Diplogasteridae, and Diplogasteritus nudicapitatus in particular, dominated the nematode community in the mixed liquor, with lesser numbers of the family Rhabditidae. No correlation was apparent between seasonal patterns of nematode species composition and densities and COD, ammonia, nitrate, nitrite, chloride or inorganic phosphate in the sewage; there was a correlation with BOD5. Maximum numbers occurred at suboptimal temperatures indicating that temperature is overriden by a combination of other factors related to sewage quality and loading. Total daily energy contributions by the nematodes indicate that their role in bacterial grazing and decomposition processes in activated sludge is negligible. This is attributable to the unstable nature of the mechanical environment and an unfavorable relationship between nematode doubling time and sewage retention times. (Author's abstract)
W88-02345

DEVELOPMENT OF PROTOZOAN AND METAZOAN COMMUNITIES IN ROTATING BIOLOGICAL CONTACTOR BIOFILMS,
New Hampshire Univ., Durham. Dept. of Civil Engineering.
N. E. Kinner, and C. R. Curds.
Water Research WATRAG, Vol. 21, No. 4, p 481-490, April 1987. 4 fig, 3 tab, 50 ref. NSF Grant DEB 811 4819 and NATO 213/84.

Descriptors: *Bioindicators, *Rotating biological contractors, *Wastewater treatment, *Wastewater, *Protozoa, Pollution load, Bacteria, Effluents.

Biofilms, in pilot-scale rotating biological contactors (RBCs) receiving 2.0, 4.0 and 6.0 g TOC/sq m/d of settled domestic sewage, were examined using light microscopy. The protozoan and metazoan communities which developed were complex and varied with the applied organic loading rate. Protozoan and metazoan succession from startup of the RBCs progressed from zooflagellates and small amoebae to free swimming bacteriovorous ciliates and then to peritrichous and carnivorous ciliates, rotifers, and large amobae. The pilot scale studies demonstrated that protozoa and metazoa may be suitable indicators of effluent quality in RBCs. (Author's abstract)
W88-02348

CRITERIA ESTABLISHING BIOFILM-KINETIC TYPES,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
M. T. Suidan, B. E. Rittmann, and U. K. Traegner.
Water Research WATRAG, Vol. 21, No. 4, p 491-498, April 1987. 5 fig, 1 tab, 13 ref. EPA Contract EPA-809750-01.

Descriptors: *Wastewater treatment, *Biofilms, *Substrates, *Microorganisms, *Model studies, *Analytical methods, Microbiological studies, Kinetics.

A graphical procedure for assessing the nature of substrate penetration within a biofilm is developed. This procedure, which is based on a measure of the effectiveness of substrate utilization by biofilm microorganisms, is used to determine when simple analytical solutions of biofilm models can be used accurately. These analytical solutions correspond to extreme values of bulk substrate concentration and cases where the biofilm is fully penetrated or deep. Minimum values of the effectiveness are related to biofilm thickness. (Author's abstract)
W88-02349

LIGHT INDUCED NITROSOMONAS INHIBITION,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
J. E. Alleman, V. Keramida, and L. Pantea-Kiser.
Water Research WATRAG, Vol. 21, No. 4, p 499-501, April 1987. 2 tab, 12 ref.

Descriptors: *Wastewater treatment, *Light effects, *Cultures, *Bioassay, *Nitrosomonas, Inhibition, Bacteria, Ammonia, Respiration.

The purpose of this study was to evaluate and verify the impact of light exposure on an enriched Nitrosomonas culture. Resting cells maintained under aerobic conditions without an exogenous ammonium-nitrogen source were fully inhibited within a 10 min period of ambient light contact (i.e. fluorescent and indirect natural room light). These cells were, however, protected against this inhibitive phenomenon during active respiration periods and during anoxic exposure conditions. Recovery, albiet partial, from such light induced inhibition was initiated after a 'dark' contact period of approx. 2.5-3 h without exogenous ammonium presence. Research involving enriched or pure Nitrosomonas cultures (e.g. batch bioassay testing) should consequently be completed under environmental conditions designed to obviate this problem. (Author's abstract)
W88-02350

STORM-SEWER FLOW MEASUREMENT AND RECORDING SYSTEM,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W88-02351

EFFECTS OF STORAGE AND PREOXIDATION ON SLUDGE AND WATER QUALITY,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
R. C. Hoehn, J. T. Novak, and W. E. Cumbie.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 6, p 67-75, June 1987. 15 fig, 1 ref.

Descriptors: *Wastewater treatment, *Preoxidation, *Sludge, *Water quality, Settling basins, Field tests, Manganese, Chlorine dioxide, Oxidation.

Ever since the city of Newport News, Va., eliminated prechlorination at its water treatment facilities in 1982 in order to control trihalomethanes, it has been plagued by deterioration of alum sludges in manually cleaned sedimentation basins and by occasional declines in settled water quality. Laboratory and field studies showed that anaerobic conditions develop rapidly in manually cleaned sedimentation basins (but not in those that are mechanically cleaned), allowing manganese to be released from the sludge into the overlying water. The use of chlorine dioxide as a preoxidant was found to suppress this release of manganese, produce sludges with improved dewatering characteristics, and lengthen filter runs. (Author's abstract)
W88-02394

TESTING OF ALUM RECOVERY FOR SOLIDS REDUCTION AND REUSE,
Environmental Engineering and Technology, Inc., Newport News, VA.
For primary bibliographic entry see Field 5F.
W88-02395

EFFECTS OF COAGULATION ON SLUDGE THICKENING AND DEWATERING,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. R. Knocke, J. R. Hamon, and B. E. Dulin.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 6, p 89-98, June 1987. 15 fig, 4 tab, 13 ref.

Descriptors: *Wastewater treatment, *Coagulation, *Sludge thickening, *Dewatering, Turbidity, Flocculation, Adsorption, Sludge, Wastewater.

The effects of coagulation mechanism (as influenced by coagulant dosage, influent turbidity, and coagulation pH) on the thickening and dewatering characteristics of aluminum and ferric hydroxide sludges were examined. Sludge thickening and dewatering improved with a reduction in coagulation pH or coagulant dosage or with an increase in influent turbidity. Enmeshment coagulation produced a large floc with a high water content, resulting in poor water removal during dewatering. Adsorption-charge neutralization coagulation yielded a smaller but much denser floc, which corresponded to greater water removal from the sludge. (Author's abstract)
W88-02397

CONDITIONING OF PULP AND PAPER SLUDGE USING DIRECT SLURRY FREEZING,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Civil Engineering.
M. Z. Ali Khan, and C. W. Randall.
Journal of Environmental Science and Health (A) JESEDU, Vol. 22, No. 2, p 105-124, February 1987. 7 fig, 2 tab, 58 ref.

Descriptors: *Wastewater treatment, *Sludge conditioning, *Sludge drying, *Pulp wastes, *Freezing, Alum, Sludge, Wastewater, Filtration.

In unique process for the conditioning and disposal of pulp and paper sludge, the sludge is slurry frozen (not solid frozen), by direct contact with the refrigerant, butane. The process, by the addition of small quantities of coagulants, such as alum, prior to freezing, results in 3 to 4 times faster dewatering rates on sand-drying beds as well as accelerated vacuum filtration rates as compared to those of the unconditioned sludge. The filter cake moisture content is only 40%. The supernatant and filtrate qualities are much better. (Author's abstract)
W88-02398

DECOLORIZATION OF DYE SOLUTIONS BY CONTINUOUS ULTRAFILTRATION,
Wroclaw Technical Univ. (Poland). Inst. of Environment Protection Engineering.
K. Majewska-Nowak, and T. Winnicki.
Desalination DSLNAH, Vol. 60, No. 1, p 59-66, September 1986. 4 fig, 2 tab, 2 ref.

Descriptors: *Water treatment, *Decolorizing, *Dyes, *Ultrafiltration, *Wastewater treatment, *Membrane processes, *Reverse osmosis, Flow, Performance evaluation, Solutions.

A method of decolorizing and concentrating aqueous solutions of organic dyes in an ultrafiltration process is described. The process involved polysulfone membranes prepared from 15% (wt.%) polysulfone solution in dimethylformamide and formed on a glass support. The experiments were carried out under static and dynamic conditions for five organic dyes of a molecular weight ranging from 327 to 1048.2. The pressure applied was 1.5 MPa. Membranes exhibiting the best properties are capable of retaining 90 to 100% of organic dyes of a molecular weight above 700 during their work under dynamic conditions. The measured volume fluxes through these membranes ranged from 0.08 to 0.18 cu m/sq m/d. (Author's abstract)
W88-02446

PERFORMANCE OF WASTEWATER STABILIZATION PONDS AT DIFFERENT DEPTHS,
Karnatak Univ., Dharwad (India). Water Pollution Research Lab.
B. B. Hosetti, and H. S. Patil.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 2, p 191-198, June 1987. 1 fig, 4 tab, 21 ref.

Descriptors: *Wastewater lagoons, *Nutrients, *Biological oxygen demand, *Wastewater treatment, *Bacteria, *Enzymes, Ponds, Wastewater, Depth, Light.

Investigations were made on wastewater ponds (cement cisterns) operated at 1.22, 1.83, and 2.44 m depths. Results revealed the layering of microorganisms at various depths. BOD and nutrient values and bacterial counts were maximum in the bottom layers and minimum at the surface in all the ponds. Concomitant with these variations, increases in pH and DO content were observed at the upper layers of the ponds. The activities of catalase, phosphatase, protease and amylase were directly related to microbial growth and activity. Low enzyme activity was recorded in the upper layers, whereas it increase with the increase in depth of the pond. It is inferred that the pond depth could be increased beyond a generally acceptable value of 1.22 m particularly in tropical countries where enough light is available. (Author's abstract)
W88-02460

OPTIMIZING THE DESIGN OF AN ACTIVATED SLUDGE/SECONDARY CLARIFIER SYSTEM VIA UNIVARIATE SEARCH TECHNIQUE,
National Univ. of Singapore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W88-02475

5E. Ultimate Disposal Of Wastes

SLUDGE AND ITS ULTIMATE DISPOSAL.
Ann Arbor Science, Ann Arbor, MI. 1981. 286 p. Edited by Jack A. Borchardt, William J. Redman, Gordon E. Jones, and Richard T. Sprague.

Descriptors: *Sludge disposal, *Waste disposal, Chemical treatment, Economic aspects, Health aspects, Toxicity, Hazardous wastes, Wastewater treatment.

This book is a compilation of papers presented at a seminar entitled 'Sludge and Its Ultimate Disposal' held at the University of Michigan on January 30, 31 and February 1, 1980. The purpose of the seminar was to explore the subject of sludge and its ultimate disposal. This area of interest is changing rapidly as the theory and technology of its subject matter become better understood. The chemical

aspects, toxicological problems and administrative difficulties involved in sludge disposal are discussed, along with the problems in the development of adequate standards to control human hazards. The ultimate objective of this exchange of ideas was to provide a reasonable and economical solution to the disposal of the final concentrated pollutants being generated in the water and wastewater industries. (See W88-01500 thru W88-01521) (Lantz-PTT)
W88-01499

INDUSTRIAL SLUDGE DISPOSAL IN MICHIGAN,
Michigan Dept. of Natural Resources, Lansing. Water Quality Div.
J. M. Bohunsky, and R. E. Schrameck.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 3-16.

Descriptors: *Industrial wastes, *Sludge disposal, *Michigan, Waste disposal, Environmental effects, Water pollution sources, Landfills, Disposal sites.

For years, environmental control specialists throughout the United States paid little attention to sludge disposal because they were unaware of the potential problems it could create. Examples of the tragic consequences of this lack of knowledge include the seepage of chemicals from the ground at Love Canal in New York, causing two hundred families to leave their homes. Examples of similar problems include the burial of hundreds of drums containing sludges at two locations in northern Oakland County. Hooker Chemical's burial of waste in Muskegon County and Velsicol Chemical Company's burial of waste in the Alma-St. Louis area are further examples of poor judgement by industry in the disposal of chemicals and sludges. Past problems with disposal of sludges and chemicals at landfill sites have made it virtually impossible to locate new disposal facilities in Michigan. Establishing a disposal facility site in the lower, more populous region of the state where such facilities are in greatest demand is especially difficult. The public does not want such a facility anywhere nearby. If sludges and hazardous wastes are to be managed successfully, sites will be needed to store and dispose of these materials. The goal of the Michigan Department of Natural Resources is to earn the confidence of the public by establishing high standards and to take quick and decisive enforcement action against violators. Once it has been proven to the general public that adequate safeguards are established and carried out, the Department will gain the trust of Michigan citizens and have less difficulty in locating needed disposal sites. (See also W88-01499) (Lantz-PTT)
W88-01500

MUNICIPAL WASTEWATER TREATMENT PLANT SLUDGE,
Michigan Dept. of Natural Resources, Lansing.
R. T. Sprague.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 17-29, 1 fig, 3 tab, 7 ref.

Descriptors: *Sludge disposal, *Municipal wastewater, *Water treatment facilities, Domestic wastes, Land disposal, Toxicity.

Municipal wastewater sludge disposal is an area of growing concern. Michigan wastewater treatment plants produce more than 1000 dry ton/day of sludge, a quantity that is expected to increase by about 50% by 1985. Further, septic tank pumpings produce approximately 100 dry ton/day of material that is very similar to residential sewage sludge. Finally, industry produces approximately 2000 dry ton/day of sludge from biologically derived processes; again, many of these materials are similar to domestic sewage sludges. As the quantity of sludge increases, so does the number of regulations attempting to control this material, as well as other potentially toxic or hazardous wastes. This has created an atmosphere of confusion, concern and misunderstanding within the sludge disposal industry. Discussed here are present and future regulations on sludge disposal in the state of Michigan. This discussion will be limited to the regulation of land application, and land disposal or reclamation projects. (See also W88-01499) (Lantz-PTT)
W88-01501

MANAGEMENT OF WATER TREATMENT PLANT SLUDGES,
Michigan State Univ., East Lansing. Coll. of Engineering.
D. A. Cornwell, and G. P. Westerhoff.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 31-62, 9 fig, 7 tab, 17 ref.

Descriptors: *Waste management, *Sludge disposal, *Water treatment facilities, *Waste disposal, *Wastewater treatment, Coagulation, Lime, Chemical treatment.

Management of water treatment plant sludges has become an increasingly difficult and expensive requirement. The most abundant types of water plant sludges are produced at chemical coagulation and lime softening plants, both of which account for about 95% of all water treated. Coagulant plants represent about 70% of all treatment plants; consequently, the management of coagulant sludges is emphasized. This discussion is presented in five general categories: (1) production and characteristics of sludge; (2) minimization of sludge generation; (3) chemical recovery; (4) treatment alternatives; and (5) ultimate disposal. (See also W88-01499) (Lantz-PTT)
W88-01502

IMPACT OF SEPTIC TANK SLUDGE ON MUNICIPAL WASTEWATER TREATMENT PLANTS,
McNamee, Porter and Seeley, Ann Arbor, MI.
R. J. Smit, and J. Kang.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 63-80, 9 fig, 6 tab, 3 ref.

Descriptors: *Septic tanks, *Septic sludge, *Municipal wastewater, *Waste treatment facilities, Mathematical models, Settling, Economic aspects, Biological oxygen demand.

A careful review of records on septage unloading and its impact on the treatment process was made for several selected wastewater treatment plants in Michigan. A mathematical model was subsequently developed to predict dynamic performance of a typical activated sludge process. Finally, an economic analysis was prepared to estimate the treatment cost for septage at a municipal treatment plant. The following summarizes the conclusions and recommendations of this paper: (1) Septage is quite variable in its characteristics. Depending on various local conditions and regulations, the strength of septage can vary by a few orders of magnitude; (2) The per capita septage generation rate varies from 71 gal/yr (for a once in four-year pumping of a 100-gal tank) to 95 gal/yr (for a once in three-year pumping of the same tank). The frequency of pumping depends on various local conditions; (3) Settling characteristics of septage needs further study; (4) The settleability of septage varies with each load. The fraction of BOD5 to be removed by settling is not well known; (5) A mathematical model for activated sludge was developed using Monod kinetics performance of an activated sludge process; and (6) Economic analysis showed that the cost for treating septage is considerably more than the usual $5 or $10 per load. Charge rates should be set to cover the actual costs of construction and operation of the septage treatment system. Separate land application of septage could be a viable alternative if the septage disposal system is planned on a regional basis. (See also W88-01499) (Lantz-PTT)
W88-01503

CASE HISTORY OF SAMPLING PROBLEMS IN A SLUDGE LAGOON,
Environmental Control Technology Corp., Ann Arbor, MI.
For primary bibliographic entry see Field 5A.
W88-01507

AGRICULTURAL APPLICATION OF SEWAGE SLUDGE,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
L. W. Jacobs.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 109-126, 2 fig, 3 tab, 16 ref.

Descriptors: *Waste disposal, *Land disposal, *Agriculture, *Sludge disposal, *Water reuse, Waste management, Public opinion, Pollutant identification, Nutrients, Metals, Salts, Organic compounds.

The application of sewage sludge to agricultural land continues to be a popular choice of municipalities selecting a sludge management option. However, land application of sludge is not without its difficulties. Gaining public acceptance of this nonconventional alternative is sometimes difficult, even for small rural communities accustomed to spreading animal wastes. Land application of sludge is especially complicated for large metropolitan areas where available farmland is several miles away and frequently across political boundaries (township, county or state). It causes problems of social acceptance, high transportation costs and lack of sufficient land areas for the large quantities of sludge produced. This chapter identifies the important factors that should be considered when evaluating the application of sewage sludge to agricultural soils as a sludge management alternative. These include: nutrients, metals, soluble salts and toxic organics contained in the sludge; sludge loading; and various land application programs. (See also W88-01499) (Lantz-PTT)
W88-01508

LANDFILLING AND RENOVATION WITH SLUDGES,
Jones and Henry Engineers Ltd., Toledo, OH.
J. C. Jenkins.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 127-136, 4 fig, 2 tab, 2 ref.

Descriptors: *Sludge disposal, *Landfills, *Land reclamation, Waste disposal, Geohydrology, Sludge cake, Environmental effects, Public opinion.

The problem of disposing of sludge will remain for a number of years. In using landfills or reclamation for disposal, a community must carefully assess all aspects of the operation. Difficult terrain characteristics, hydrogeological and sludge cake characteristics all enter into an evaluation of sludge disposal. Codisposal appears to be the preferred method of disposal. The advantages include little regulatory delay in approving the program because the site is usually in operation. Because the site already exists, there will be less impact from odors, traffic, aesthetics and other concerns than will likely be found in a new site using sludge only. Public opposition to the operation will often be less than for a sludge-only landfill. Using sludges in landfills can increase odor, leachate and operating problems. Nevertheless, landfilling sludge is a viable disposal option. (See also W88-01499) (Lantz-PTT)
W88-01509

AESTHETIC RENOVATION,
Site Planning Development Inc., Charlevox, MI.
J. W. Campbell.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 137-146, 5 fig, 4 tab.

Descriptors: *Waste renovation, *Sludge disposal, *Waste treatment, *Land disposal, *Waste disposal, Monitoring, Costs, Agriculture, Revegetation.

Prior to 1979 the Charlevoix Sewage Treatment Plant placed liquid sewage sludge in drying beds and trucked the dried material to an adjacent landfill. Through the cooperation of the city of Charlevoix, the Charlevoix Township Supervisor, District Health Department No. 3, Michigan Depart-

ment of Natural Resources and the Medusa Cement Company, Site Planning Development, Inc. was authorized to implement a land reclamation program utilizing this sludge. Sludge can be a valuable resource; however, it is not utilized actively as often as it is discarded as a waste product. Land application can be environmentally safe and beneficial to land reclamation and revegetation. However, when sludge is used for land reclamation, guidelines must be followed to establish application rates. The program allowed 3000 gal/acre per application of liquid digested sludge and an annual limit of 18 dry ton/acre. Based on this program in Charlevoix, the following conclusions can be drawn: (1) participation by all governmental units and corporate units can initiate a unique sludge disposal program; (2) the positive effects of the program must be analyzed and monitored yearly and recorded to ensure its continued success; (3) as the cost of commercial fertilizer rises, the proper use of sludge will be even more important to the reclamation industry; (4) as new equipment and application techniques are developed, the cost of application should decrease; and (5) efficient use of sludge can result in a successful revegetation program. (See also W88-01499) (Lantz-PTT)
W88-01510

LOW-RATE CROPLAND APPLICATION: A CASE HISTORY IN JACKSON, MICHIGAN,
Jackson City Waste Water Treatment Plant, MI.
D. C. O'Neill, and W. W. Farmer.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 147-164, 2 fig, 11 tab, 7 ref.

Descriptors: *Sludge disposal, *Case studies, *Water reuse, *Jackson, *Michigan, Agriculture, Crops, Economic aspects, Public participation, Monitoring, Costs.

To have an environmentally acceptable sludge management program, the city of Jackson, Michigan has established the practice of low-rate cropland application as part of its overall sludge management program. This program has not only provided the city with an economical means of managing a significant amount of its wastewater sludge, but has also provided participating farmers with valuable crop nutrients and soil conditioners. The city performs extensive monitoring as part of the program management to protect against any soil or crop degradation. Detailed discussions presented on the development and implementation of the program show the importance of public participation, criteria for site selection, calculation of sludge application rates; development of a monitoring program; selection of equipment; responsibilities of the personnel; and costs of the operation. Finally, areas of further research are presented in an effort to answer questions that may have a vital on future sludge disposal. (See also W88-01499) (Lantz-PTT)
W88-01511

SEWAGE SLUDGE COMPOSTING AT THE BLUE PLAINS WASTEWATER TREATMENT PLANT, WASHINGTON, DC,
District of Columbia Dept. of Environmental Services, Washington.
F. A. Riddle.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 165-170.

Descriptors: *Septic sludge, *Wastewater disposal, *District of Columbia, *Composting, *Sludge disposal, Costs, Site selection, Sludge, Screening.

The Blue Plains Wastewater Treatment Plant in Washington, DC treats the wastewater from that city and much of its suburban area. Between 20 and 30 years ago, approximately 100 ton/day of digested sludge at 20% solids were produced. It was left in an open field to dewater further and to age for about a year, then was given away for soil conditioning, lawn dressing, etc. Any possible impact on the health of sludge users and on the environment was not considered to be a problem. But the area grew and the plant had to be expanded and upgraded, some phases of which are still underway. Today, the plant is a 309 million gpd plant and produces approximately 1300 ton/day of sludge at 20% solids. Of this quantity, 350 tons are digested and the remainder is undigested or raw. In the search for an improved way to dispose of this sludge, Blue Plains has undertaken a large-scale project to compost approximately 300 tons/day of raw sludge using the forced-aeration, static pile method developed by the U.S. Department of Agriculture, Beltsville, Maryland. This process, along with screening, site selection and improvement of sites and costs, are all discussed. (See also W88-01499) (Lantz-PTT)
W88-01512

CALCINING SLUDGE - A PARTIAL SOLUTION,
Ann Arbor Utilities Dept., MI.
J. C. Scott.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 171-175, 1 ref.

Descriptors: *Calcining, *Sludge disposal, *Waste disposal, *Ann Arbor, *Michigan, Land disposal.

A facilities report prepared in 1962 is the basis of Ann Arbor, Michigan's, water treatment plant sludge disposal program. The plant was completed in 1969 at a cost of $1.2 million but it was not until 1979 that all sludges were processed through the calciner, a 17-year lead time. Problems connected with plant operation include chemical scaling of the high-speed exhaust fan which produced equipment imbalance; a service life shorter than anticipated; decreased settleability of sludge in the lagoons because of high concentrations of magnesium hydroxide; and inadequate thickener capacity for the calciner. Actions taken to alleviate some of these problems include construction of a sludge recarbonation basin, forced ventilation of the calciner, improvement of the sludge lagoon dikes, and elimination of the use of polymers and sodium aluminate in the water treatment plant. In addition, thickener capacity was doubled, two pressure filters are scheduled for installation, and plans made to discontinue the recarbonation process because of its negative impact on particle size. The dried cake from the filter process will be trucked to the sanitary landfill. (See also W88-01499) (Lantz-PTT)
W88-01513

ENVIRONMENTAL IMPACTS OF SLUDGE DISPOSAL,
New York State Coll. of Agriculture and Life Sciences, Ithaca.
For primary bibliographic entry see Field 5C.
W88-01514

IMPACT OF SLUDGE INCINERATION ON THE ENVIRONMENT,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 5C.
W88-01515

ULTIMATE DISPOSAL OF HAZARDOUS SLUDGE VIA SOLIDIFICATION,
Weston (Roy F.), Inc., Woburn, MA.
R. B. Pojasek.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 211-215, 7 ref.

Descriptors: *Hazardous wastes, *Sludge disposal, *Solidification, Waste disposal, Wastewater treatment.

Recent federal regulations issued under the Resource Conservation and Recovery Act (RCRA) no longer exclude from control under subtitle C sewage sludge from publicly owned treatment works (POTW). Pending the future promulgation of a comprehensive sewage sludge regulation, sewage sludge that exhibits any of the specified characteristics of hazardous waste established in the regulations must be managed as a hazardous waste. This new direction taken by the U.S. Environmental Protection Agency (EPA) is bound to change the operation of many of those involved in sludge management. A representative sample of every sludge must be tested against the following four EPA characteristics: (1) ignitability, (2) corrosivity, (3) reactivity, and (4) extraction procedure (EP) toxicity. If the sludge fails any of these tests it must be declared as hazardous, and the proper EPA notification form must be filed. The sludge will then be assigned an EPA hazardous waste number. A 'hazardous' sludge must be transported, stored, treated and disposed of in a manner prescribed by the EPA hazardous waste rules and regulations. Nonhazardous sludges currently fall under the less restrictive and less expensive subtitle D regulations. Numerous permits will be required for handling hazardous sludges. Solidification is a treatment process that can operationally convert a 'hazardous' sludge into a nonhazardous material, thus avoiding some of the disposal problems. The concept of this conversion is discussed. (See also W88-01499) (Lantz-PTT)
W88-01516

MONITORING THE RESPONSE OF SOILS AND CROPS TO SLUDGE APPLICATIONS,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 5C.
W88-01517

LAND DISPOSAL EFFECTS ON GROUNDWATER,
Michigan Dept. of Public Health, Lansing. Bureau of Environmental Occupational Health.
For primary bibliographic entry see Field 5C.
W88-01519

CADMIUM EFFECTS ON MYCORRHIAGE: A RESEARCH NEED IN FORESTLAND APPLICATION OF SLUDGE,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W88-01520

FEDERAL REGULATORY CONSIDERATIONS IN SLUDGE UTILIZATION,
Environmental Protection Agency, Chicago, IL. Water Div.
For primary bibliographic entry see Field 5G.
W88-01521

SUMMARY OF THE POINTE MOUILLEE CONFINED DISPOSAL FACILITY,
Army Engineer District, Detroit, MI.
P. B. McCallister.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 15-21, 4 fig.

Descriptors: *Pointe Mouillee, *Dredging, *Detroit River, *Waste disposal, Navigation, Channels, Navigation channels.

The Detroit River, one of the Great Lakes Connecting Channels, is the only access to the Upper Great Lakes for a very large volume of waterborne cargo. In recent years, the annual tonnage, not including Canadian cargo, has ranged from 111 million tons in 1965 to 78.5 million tons in 1977. The volume shipped is dependent upon need and channel depth. Above average water levels in the Great Lakes have allowed fairly unrestricted movement of ships through the shipping lanes. But, if the lakes drop, this will no longer be the case as the Detroit River channel has not been dredged since 1969, and has become dangerously less than the depths needed to provide safe drafts of 25.5 ft below the International Great Lakes Datum (IGLD). The major underlying reason for no dredging during this time period is the lack of an approved disposal area for the polluted dredged material. The US EPA classified the sediments of the Detroit River as polluted. In accordance with the agreement with the State of Michigan, no open-lake disposal of polluted materials can be made in the waters of the state. (See also W88-01522) (Lantz-PTT)
W88-01523

ANALOGY AND DIFFERENCES BETWEEN COAL SLURRY TRANSPORT SYSTEMS AND HYDRAULIC DREDGING,
IHC Holland N.V., Papendrecht (Netherlands).
For primary bibliographic entry see Field 8H.
W88-01528

TECHNIQUES FOR LONG-TERM MANAGEMENT OF CONFINED DISPOSAL AREAS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
M. E. Poindexter.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 71-76, 2 fig, 8 ref.

Descriptors: *Waste management, *Dredging, *Waste disposal, Disposal sites, Long-term management, Mathematical models, Management planning, Storage capacity.

Systematic management of confined dredged material disposal sites is becoming increasingly necessary as competition for land use intensifies in regions in which most dredging projects are located. Long-term management of either single or multiple disposal sites entails determination of the storage capacity required to contain the sediments to be dredged over a period of years. Techniques for constructive management of confined disposal sites have been developed at the US Army Engineers Waterways Experiment Station. Techniques to be utilized in the long-term management of confined dredged material disposal areas are presented. The large strain consolidation behavior of dredged material and use of an available finite strain mathematical model are discussed. Recommendations are made concerning operation of the disposal site(s) to maximize potential service life or available storage capacity. (See also W88-01522) (Lantz-PTT)
W88-01529

DREDGED MATERIAL DISPOSAL MANAGEMENT MODEL,
Hydrologic Engineering Center, Davis, CA.
D. T. Ford.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 77-83, 2 fig, 4 tab, 3 ref.

Descriptors: *Waste disposal, *Dredging, *Waste management, *Model studies, Management planning, Costs, Long-term planning, Leases, Disposal sites.

The Dredged Material Disposal Management Model (D2M2) is a simulation-optimization model designed to provide information required to answer the following disposal management questions: (1) If a specified long-term operation policy is followed for an existing or proposed dredged material disposal system, what is the final status of the system, given the initial conditions, system physical and economic characteristics, and dredged material volume estimates, the cost of following the operation policy, and must additional disposal site capacity be provided; (2) What is the least costly long-term operation policy for an existing or proposed disposal system, given initial conditions, system physical and economic characteristics, and dredged material volume estimates; (3) What is the least costly method to provide the additional volume required; and should expired leases be extended, or should new sites be acquired; (4) If new sites are to be acquired, what is the least costly combination of sites and what is the least costly sequence for acquiring these sites; and (5) Are material management alternatives, such as transferring material or resting sites, cost effective. (See also W88-01522) (Lantz-PTT)
W88-01530

BENTHIC RESOURCES ASSESSMENT TECHNIQUE, A METHOD FOR QUANTIFYING THE EFFECTS OF BENTHIC COMMUNITY CHANGES ON FISH RESOURCES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5C.
W88-01531

LONG-TERM MONITORING OF CE HABITAT DEVELOPMENT ON DREDGED MATERIAL SITES, 1974-84,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5C.
W88-01533

CAPPING CONTAMINATED DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. Gunnison, J. M. Brannon, and R. E. Hoeppel.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 125-130, 2 fig, 5 tab, 4 ref.

Descriptors: *Waste disposal, *Waste management, *Dredging, *Contaminated sediments, *Capping, *Water pollution prevention, *Water quality control, Monitoring, Bioaccumulation, Heavy metals.

Capping contaminated dredged material with clean material has been used to reduce the ecological impact of dredged material disposal in open water Monitoring of capped disposal sites has shown that capping is technically feasible and that the caps are stable under normal tidal and wave conditions. Bioaccumulation studies conducted in the field have been inconclusive as to the ability of capping to prevent contaminant uptake by organisms. In the New York Bight, a mussel bioaccumulation study at the capping site showed low body burdens which could have been due to bioconcentration of contaminants from ambient water as much as from the nearby sediments. In Long Island Sound, mussels were also suspended in the water column at the sand and silt capped sites of the Stanford-Norwalk capping project. Concentrations of Co, Cu, Hg, Zn, and V fluctuated in the mussels over time, but these changes were thought to be unrelated to the caps because no differences in spatial concentration were detected. Determining the ability of caps to isolate contaminated dredged material from the water column has proven to be a difficult field problem. Contaminants that organisms encounter and bioaccumulate in the water column can originate from many sources other than dredged material. (See also W88-01522) (Lantz-PTT)
W88-01535

USE OF A BIOASSAY TO EVALUATE THE BIOACCUMULATION OF CONTAMINANTS BY ANIMALS COLONIZING A WETLAND CREATED WITH CONTAMINATED DREDGED MATERIAL,
Hoofdgroep Maatschappelijke Technologie TNO, Apeldoorn (Netherlands).
For primary bibliographic entry see Field 5B.
W88-01536

PREDICTION AND FIELD EVALUATION OF THE WATER QUALITY OF EFFLUENT FROM CONFINED DISPOSAL AREAS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W88-01537

DEVELOPMENT OF THE DUTCH POLICY CONCERNING DREDGED MATERIAL DISPOSAL,
Ministry of Transport and Public Works, The Hague (Netherlands).
For primary bibliographic entry see Field 6E.
W88-01538

DEVELOPMENT OF CRITERIA FOR THE DREDGING AND DISPOSAL OF CONTAMINATED DREDGED MATERIAL,
Rotterdam Public Works Dept. (Netherlands).
T. Vellinga.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 149-162, 3 fig, 1 tab.

Descriptors: *Dredging, *Waste disposal, *Contaminated sediments, *Regulations, Standards, Legal aspects, Economic aspects, Turbidity, Silt.

In the Port of Rotterdam and the adjacent estuarine area approximately 20 million cu m is dredged annually. The degree of contamination of the dredged material plays an important role in the choice of the method of work; it is therefore necessary to establish criteria for the selection of the work method. The boundary conditions for the establishment of criteria are: (a) Acceptability with regard to the environment; (b) National law and international agreements; (c) Technical and economic feasibility; and (d) Feasibility from the point of view of both management and enforcement. A classification of dredged material is being developed for the Rotterdam area. The present classification is based upon the mixing factor between contaminated fluvial silt and very lightly contaminated marine silt. Knowledge of the boundary conditions for development of the criteria is at present insufficient to formulate clearly defined criteria and thus is the subject of a comprehensive research program. A part of this, relating to the investigation of the nature, extent, and dispersion of the contaminants which are brought into the environment as a result of dredging and disposal underwater is explained. The turbidity which occurs as a result of dredging operations is generally known and, depending upon the dredge and the mode of work, can be plotted against the dredging costs. (See also W88-01522) (Lantz-PTT)
W88-01540

CAPPED IN-WATER DISPOSAL OF CONTAMINATED DREDGED MATERIAL BY THE US ARMY ENGINEER DISTRICT, SEATTLE,
Army Engineer District, Seattle, WA. Seattle District.
A. Sumeri.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 163-168, 5 fig.

Descriptors: *Waste disposal, *Contaminated sediments, *Dredging, *Seattle, *Capping, Water pollution control, Field tests, Sand, Cohesion, Monitoring.

The Seattle District and the US Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi, are cooperating in a field demonstration study to evaluate the effectiveness of dumping contaminated dredged material in a subaqueous depression and capping it by slowly releasing sand from a bottom-dump barge. This discussion is limited to summarizing Seattle District's operational aspects, as WES data gathering and evaluation are still under way. Only preliminary conclusions, mainly derived from Seattle District's physical operations, can be presented until the WES study with its broader evaluation is completed. These preliminary conclusions include: (1) Conventional dredging equipment and disposal techniques can be effectively used to dispose of dredged material in capping; (2) Standard survey equipment and survey control are necessary and are adequate to precisely dump on target; (3) The cohesive fine-grained material rapidly emptied out of the barge and quickly moved to the bottom as a unit with considerable energy; and (4) Relatively shallow depressions with steep side slopes appear to reduce significantly the outward surge of dumped cohesive dredged material. (See also W88-01522) (Lantz-PTT)
W88-01541

DREDGING OF POLLUTED SEDIMENT IN THE FIRST PETROLEUM HARBOR, ROTTERDAM,
Volker (Adriaan) Dredging Co., Rotterdam (Netherlands).
K. d'Angremond, A. J. de Jong, and C. P. de

Waard.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 169-190, 17 fig, 1 tab, 3 ref.

Descriptors: *Dredging, *Contaminated sediments, *Petroleum Harbor, *Rotterdam, Waste management, Turbidity.

Papers previously published by the Municipality of Rotterdam on the removal of polluted bottom sediments from the First Petroleum Harbor explain that after long consideration it was decided that polluted material would be buried in deep pits in the bottom of the same harbor. Actual dredging operations in the First Petroleum Harbor have to fulfill some very strict requirements. First, the sediment has to be dredged, transported, and dumped with situ density because of the available space for disposal. Second, turbidity has to be avoided both at the dredging and the disposal location. For this reason the cutter dredge OTTER was adapted and equipped with a specially designed suction head instead of the traditional cutter. Moreover, a special installation handled the methane gases available in the bottom sediment. This avoided negative effects in the suction process and also prevented escaping gas at the disposal site from causing turbidity. Finally, process control equipment was installed to avoid unnecessary dilution of the dredged material. (See also W88-01522) (Lantz-PTT)
W88-01542

MANAGEMENT STRATEGY FOR DISPOSAL OF DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
N. R. Francingues.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 195-199, 1 fig.

Descriptors: *Waste disposal, *Waste management, *Dredging, Site selection, Contaminated sediments, Pollutant load, Management planning.

The diversity of disposal alternatives and techniques for management of contaminated dredged material requires the development of an overall management strategy for disposal. The selection of an appropriate strategy is dependent on the nature of the dredged material, nature and level of contamination, available dredging alternatives, project size, and site-specific conditions, all of which influence the potential for environmental impacts. Technical feasibility, economics, and other socio-economic factors must also be considered in the decisionmaking process. The management strategy presented here mainly considers the nature and degree of contamination, potential environmental impacts, and related technical factors. The strategy is based on findings of research conducted by the Corps of Engineers, EPA, and others over the past 10 years and experience in actively managing dredged material disposal. (See also W88-01522) (Lantz-PTT)
W88-01544

PREVENTION OF WATER POLLUTION AND PLAN FOR THE EXPLOITATION OF THE ASH TIP OF THE LA ROBLA CONVENTIONAL POWER STATION,
EPTISA-GHESA-TRSA-Empresarios Agrupados, Madrid (Spain).
C. Alvarez Fernandez, A. Fernandez Uria, and M. Boned Niell.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 605-613, 4 fig, 2 tab, 2 ref.

Descriptors: *Water pollution prevention, *Water quality control, *Ash tips, *Powerplant wastes, *Waste disposal, *Waste dumps, *Powerplants, Bernesga River, Geohydrology, Aquifers, Erosion, Water quality.

The La Robla Conventional Power Station in the province of Leon is situated south of the locality of the same name, on the alluvium of the River Bernesga. The fuel used for the Power Station is coal, which results in a considerable production of ash. Consequently the formation of an ash tip is required in order to meet safety requirements with a minimum or no environmental impact. The ash and slag tip of the power station is located on the south-western slope of a hill ridge constituted by sandstones and oligocene conglomerates which are practically impervious, excepting a zone of surface meteorization of slight thickness. This hill is situated between the Rebocan stream and River Bernesga, in the proximities of the confluence of both. The study showed that the hydrogeological conditions maintain both the miocene detritic aquifer and the quaternary alluvium outside a possible pollutant effect on the ash tip. The plan for the ash tip minimizes the ash front exposed to the wind. A system is proposed in which the valley will be filled forming three terraces with steps 20 m high. (See also W88-01554) (Lantz-PTT)
W88-01555

MIGRATION AND CONTAINMENT OF LEACHANTS FROM URANIUM TAILINGS PONDS,
Carleton Univ., Ottawa (Ontario). Inst. of Civil Engineering.
G. E. Bauer.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 623-632, 6 fig, 1 tab, 5 ref.

Descriptors: *Path of pollutants, *Water pollution control, *Uranium, *Saskatchewan, *Ontario, Confinement pens, Regulations, Waste management, Water pollution prevention.

Two provinces, Saskatchewan and Ontario, are the major uranium producers in Canada. Prior to 1975, approximately one hundred million tons of tailings were deposited over a surface area of more than 50 sq km. All of these tailings were placed into conventional confinement structures, predominantly tailings ponds, with permeable embankments. The new regulations put forward at the beginning of 1980 for the design and operation of uranium waste management systems are to provide permanent confinement of all solid waste materials and also require that the liquid wastes are free from contaminants. (See also W88-01554) (Author's abstract)
W88-01557

PLANNING AND DESIGN OF COAL WASTE DISPOSALS IN VIEW OF GROUNDWATER PROTECTION,
For primary bibliographic entry see Field 5G.
W88-01565

DESIGN AND MANAGEMENT OF DREDGED MATERIAL CONTAINMENT AREAS TO IMPROVE HYDRAULIC PERFORMANCE,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
F. D. Shields, E. L. Thackston, P. R. Schroeder, and D. P. Bach.
Available from the National Technical Information Service, Springfield, VA. 22161. Technical Report D-87-2, June 1987. Final Report. 137 p, 36 fig, 13 tab, 35 ref, 3 append.

Descriptors: *Waste disposal, *Dredging, *Containment facilities, *Hydraulic structures, Disposal sites, Suspended solids, Dikes, Hydraulic properties, Design criteria, Pollutant load, Model studies.

Dredged material is often disposed into diked containment areas (DMCAs). Typically, the dredged material is pumped into a containment area as a slurry that is 10% to 20% solids by weight. Water and solids separate in the containment area because of gravity sedimentation, and the clarified water is discharged over a weir and through a culvert to a receiving water body. The suspended solids concentration of DMCA effluent is inversely related to the residence time of water in the DMCA. This study presents observed residence time distribution data from some 12 DMCAs. These data were collected by injecting Rhodamine WT dye at the inflow point and monitoring dye concentration in the outflow. The resultant time-concentration curve is identical to the residence time distribution during the dye test. In addition, similar data for chlorine contact chambers, physical models, and waste stabilization ponds found in the literature are also examined. A composite data set from all different sources showed a strong relationship between the ratio of mean residence time to theoretical residence time (theoretical residence time is equal to the pond volume divided by the average flow rate) and the point length-width ratio. Baffles or spur dikes can be used to increase the effective length-to-width ratio of a given DMCA, thereby increasing the mean residence time without increasing the overall size. The relationship between mean residence time and length-width ratio was incorporated into the DMCA design procedures, and a process for selecting DMCA size, shape, and spur dike layout to achieve minimum cost resulted. (Lantz-PTT)
W88-01602

RECLAMATION AND REDEVELOPMENT OF CONTAMINATED LAND: VOLUME I, U.S. CASE STUDIES,
Research Triangle Inst., Research Triangle Park, NC.
G. L. Kingsbury, and R. M. Ray.
Report No. EPA/600/2-86/066, August 1986. 186 p, 4 fig, 11 tab, 58 ref, 2 append. EPA Contract No. 68-03-3149, 23-1.

Descriptors: *Cleanup operations, *Land reclamation, *Disposal sites, Hazardous wastes, Public policy, Costs, Economic aspects.

There are numerous cases in the United States where uncontrolled dumping or industrial spills have contaminated properties with hazardous materials (now more than 18,000 sites have been inventoried by U.S. EPA). Since many of these properties are in prime urban locations, issues surrounding the reclamation and redevelopment of contaminated properties have assumed national importance. The principal objective of this study has been to document with case studies relationships between site remediation methods, cleanness criteria, and redevelopment land uses. After extensive interviews with Federal and State officials in all 50 States, 16 uncontrolled hazardous waste sites were selected for detailed study. For each of these sites, remedial actions have been undertaken or are planned with some upgraded redevelopment of the property in mind. Redevelopments include single- and multi-family residential, recreational, commercial, institutional, and light industrial land uses. Two distinctly different types of redevelopment efforts were encountered -- public initiated projects and developer-initiated projects. In the case of public-initiated projects (for example, most Superfund sites), immediate concerns for community health are paramount, and site reuse, if any, tends to be incidental to site cleanup. In the case of developer-initiated projects, the developer attempts to recover site cleanup costs through resale of the property. Thus, he simply diverts into cleanup operations money that would otherwise be used to purchase uncontaminated land. The economic feasibility of a developer-initiated project may depend directly on the standard of cleanness required of a site for a particular redevelopment type. Since property decontamination standards and guidelines have not been formulated for most situations, some confusion exists and hence, developers generally view contaminated site reclamation/redevelopment projects as undesirable ventures. (Author's abstract)
W88-01606

CHARACTERISTICS OF BIG SANDY RIVER DRAINAGE BASIN WATER AND OF SALTY AQUIFER WATER,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. J. Eisenhauer.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB87-100093, A03 in paper copy, A01 in microfiche. Report No. REC-ERC-87-2, March 1987. 21 p, 5 fig, 11 tab, 13

ref.

Descriptors: *Big Sandy River, *Saline water, *Salinity, *Water pollution sources, *Disposal wells, *Aquifers, Brackish water, Groundwater quality.

The Bureau of Reclamation is conducting studies to find methods of disposal for high-salinity water from 16 identified sources to prevent these waters from entering the Colorado River. The Big Sandy River is one source that contributes 6.2% of the identified salt load, or 152,000 metric tons (167,000 tons), annually. Basic data on the physical and chemical properties of brackish waters that enter the Big Sandy River and ultimately contribute to the Colorado River salinity were needed to determine methods of disposal. Consequently, the Bureau of Reclamation contracted for the drilling of 99 wells along the entire Big Sandy River Basin. Site sampling and analytical programs were conducted from 1976 to 1984. The data obtained were evaluated for physical and dissolved chemical characteristics of water from the 99 wells. Characteristics of water included physical properties, major salt constituents, trace metals, trace elements, trace anions, radioactivity, and organic compounds. Based on well water analyses, a salty aquifer that pollutes the Big Sandy River was identified and located. This Big Sandy Salty Aquifer is identified by seven wells with water containing exceptionally high salinity (an average of 7050 mg/L). These wells are located within an 8- by 8-km (5- by 5-mi) area. (Author's abstract)
W88-01614

ENVIRONMENTAL ENGINEERING AND SANITATION,
For primary bibliographic entry see Field 5D.
W88-01659

SEVENTH ANNUAL MADISON WASTE CONFERENCE: MUNICIPAL AND INDUSTRIAL WASTE.
Wisconsin Univ.-Madison. Dept. of Engineering and Applied Science.
September 11-12, 1984. 1984. 521 p.

Descriptors: *Waste disposal, *Land disposal, *Landfills, *Hazardous materials, *Leaching, Fate of pollutants, Monitoring, Site selection, Conferences, Waste management, Solid waste disposal, Leachates, Wastewater disposal, Design criteria, Linings, Industrial wastes, Sanitary landfills.

The Madison Waste Conference was established to provide a technical forum for current topics in land application and landfilling of industrial and municipal waste and to provide advanced technical training and interchange on important issues facing professionals working on land application and disposal systems. The proceedings contain technical papers which the Conference Committee selected from abstracts. These papers cover the following topics: disposal site monitoring, land application/disposal of wastes, remedial action assessment and implementation, contaminant chemistry, remedial action case studies and evaluation, site design to protect groundwater, landfill soil and clay liners, and landfill design operation. An index of terms from the 1982, 1983, and 1984 conferences is included. (See W88-01726 thru W88-01757) (Geiger-PTT)
W88-01725

USE OF MULTI-LEVEL GAS DRIVEN SAMPLERS AND CONVENTIONAL MONITORING WELLS FOR EVALUATION OF GROUNDWATER CONTAMINATION AT AN UNCONTROLLED HAZARDOUS WASTE SITE,
NUS Corp., Pittsburgh, PA.
A. Nazar, J. Prieur, and D. Threlfall.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 3-13, 5 fig, 1 ref.

Descriptors: *Monitoring, *Hazardous materials, *Waste dumps, *Test wells, *Leaching, Fate of pollutants, Leachates, Groundwater pollution, Sampling, Land disposal, Groundwater level, Industrial wastes, Organic compounds, Inorganic compounds, Pesticides, Path of pollutants.

A groundwater monitoring program using polyvinyl chloride monitoring wells and multi-level gas driven samplers was implemented at an uncontrolled hazardous waste site. The primary objectives of the program were to define the hydrogeologic regime and determine the horizontal and vertical extent and distribution of contaminants. The multi-level samplers were utilized to supplement the information obtained from the conventional monitoring wells by providing data on vertical point contaminant concentrations and vertical head distributions. The advantages of using the multi-level samplers were: the ability to obtain vertical point contaminant concentrations; less purge water to collect and store vs. bailing or pumping; less potential dermal contact during sampling; and the systems were more cost effective with depth. The primary disadvantages were: the low volume of sample obtained during each purge; limited aquifer characteristic evaluation once the system is in place; and icing of the discharge line during periods of extreme cold. (See also W88-01725) (Author's abstract)
W88-01726

MIGRATION AND DEGRADATION PATTERNS OF VOLATILE ORGANIC COMPOUNDS,
Warzyn Engineering, Inc., Madison, WI.
For primary bibliographic entry see Field 5B.
W88-01727

COMPARISON OF LABORATORY AND FIELD DETERMINED VALUES OF HYDRAULIC CONDUCTIVITY AT A WASTE DISPOSAL SITE,
Illinois State Geological Survey, Urbana.
B. L. Herzog, and W. J. Morse.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 30-52, 9 fig, 2 tab, 8 ref. EPA Contract No. R810442-01.

Descriptors: *Permeability coefficient, *Field tests, *Waste disposal, *Waste dumps, *Piezometers, Monitoring, Fate of pollutants, Soil types, Sampling, Loess, Comparison studies, Path of pollutants.

The hydraulic conductivity of fine-grained deposits from a waste disposal site in southern Illinois was determined by both laboratory and field tests. Laboratory tests on undisturbed and recompacted samples were performed in a Harvard-type miniature permeameter. Field methods included slug tests analyzed by two different methods and recovery tests. Geometric means of hydraulic conductivity determined by the three methods were similar for each of the geologic units tested. Most average laboratory-determined values were at least one order of magnitude lower than their field counterparts. Slug tests were also conducted on angle-holes in an attempt to take into account vertical fractures. Average values from field tests of the angle-holes were greater than for the vertical holes, leading to the tentative conclusion that the vertical fractures cause the hydraulic conductivity of material to be higher than that indicated by the results from the vertical holes. Results of this study indicate that field tests should be used instead of, or in addition to, laboratory tests when determining hydraulic conductivity at waste disposal sites. (See also W88-01725) (Author's abstract)
W88-01728

LAND TREATMENT EXAMPLE OF AN INTEGRATED MANAGEMENT SYSTEM,
Sheaffer and Roland, Inc., Chicago, IL.
K. W. McBrien, D. R. Wyosnick, and W. G. Goelzer.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 53-63, 1 fig, 3 tab.

Descriptors: *Wastewater renovation, *Land disposal, *Wastewater disposal, *Sludge disposal, *Wastewater irrigation, Anaerobic digestion, Sludge utilization, Waste heat, Alcohols, Waste management, Case studies, Cost analysis.

Due to serious operational problems, the Landis Sewerage Authority (LSA), Vineland, New Jersey was ordered by the Environmental Protection Agency to correct its wastewater management system. A wastewater reclamation system, using land application of treated wastewater effluent, was designed to produce a long term solution to these problems. Features of the new system include primary clarifiers and rapid infiltration basins. To control the groundwater level beneath and around the infiltration basins, the filtered effluent is captured by an underdrainage collection system with an area of influence of approximately 800 acres. The collected rapid infiltration bed effluent will be stored in a lagoon until it is required for irrigation. The nutrient rich effluent will be distributed by means of a center pivot spray irrigation system onto approximately 850 acres of crops which will be grown on LSA owned lands. Primary sludge from the sedimentation tanks will be pumped to anaerobic digesters. Biogas produced by the digestion facilities will be utilized for power and heat production. Digested sludge will be transferred daily to a sludge storage tank until it can be applied to the soil to aid in boosting crop yields. An on-site alcohol production facility will be integrated with other facilities of the LSA Wastewater Management System. Feedstock for the still will be corn grown on LSA owned lands. Brewer's mash, a by-product of the still, is rich in protein and can be sold as an animal feed supplement. The integrated wastewater management system designed for LSA will not only solve the problems of high groundwater levels and the subsequent water pollution, but it will add clean water to the groundwater table and surface waters through nonpoint source discharge. Cost-effectiveness studies of the alcohol still and construction costs estimates for the integrated system are discussed. (See also W88-01725) (Geiger-PTT)
W88-01729

DESIGN OF LAND APPLICATION PROGRAMS FOR LARGE MUNICIPAL SYSTEMS VIA CONTRACTUAL SERVICES: A CASE STUDY - WASHINGTON, D.C.,
Bio Gro Systems, Inc., Annapolis, MD.
J. B. Forst, and D. L. Jarrett III.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 64-75.

Descriptors: *Land disposal, *Sludge disposal, *Wastewater disposal, *Case studies, *Waste disposal, Monitoring, Site selection, Soil tests, Permits, Waste management, Dewatering, Sludge utilization, Public relations.

Increasing sludge disposal costs (e.g. incineration, landfilling), has led to the selection of options which reutilize sludges. Cropland application has become a very successful reutilization method for large wastewater treatment systems. BioGro Systems, a private company, has developed a number of large scale, multiple-year land application programs for industries and municipalities. The essential elements of a land application program include sludge and soil evaluation, site permitting, monitoring and reporting, public relations and coordination of operating and management factors. Sludges from the Washington, D.C. Blue Plains facility have been successfully land applied in a wide geographic area around the city for over two years. A project of this size (1200 wet tons per day) serves as an illustration of most of the factors which must be addressed in a successful agricultural utilization program. (See also W88-01725) (Author's abstract)
W88-01730

IMPLEMENTING ONTARIO'S GUIDELINES FOR USING MUNICIPAL SEWAGE SLUDGE IN AGRICULTURE,
Ontario Ministry of the Environment, Toronto. Waste Management Branch.
F. J. Iliffe.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 76-99, 5 fig, 7 tab, 11 ref.

Descriptors: *Ontario, *Sludge disposal, *Land disposal, Sludge utilization, *Waste management, Case studies, Fertilizers, Sludge drying, Waste disposal, Solid waste disposal, Coast analysis, Standards.

Ontario's Guidelines for utilizing municipal sewage sludge in agriculture are based on ten years of extensive research costing $2.4 million. The guidelines encourage the use of sludge, protect long-term land productivity, food quality, the health of crop consumers and environmental quality, and ensure that the nitrogen, phosphorus, organic matter and micronutrients in sludge will benefit crops. The implementation procedures used during 1979-1982 are discussed along with on-going review processes. The need for liaison between environmentalists, agricultural researchers, municipalities, farmers and the public is stressed. Some technical and administrative problems of the Ontario Guidelines are analyzed. A computer-assisted sludge management program developed by Halton, Canada and Ontario is outlined. It is concluded that guidelines should reflect both the current state-of-the-art and the current knowledge and environmental awareness of municipalities, haulers and farmers. Data obtained before a program is initiated is often unreliable. Data accuracy increases as municipalities become more aware of needs and costs. More research is needed on the land use of wastes such as food processing wastes, and on the incidence and effects of chemically complex organic contaminants in sewage sludge. (See also W88-01725) (Geiger-PTT)
W88-01731

PRETREATMENT AND LAND DISPOSAL OF INDUSTRIAL WASTE,
Cross/Tessitor and Associates, Orlando, FL.
F. L. Cross Jr., and J. L. Tesitore.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 100-107, 4 fig, 4 tab.

Descriptors: *Wastewater treatment, *Waste disposal, *Land disposal, *Industrial wastes, *Wastewater disposal, Sludge drying, Flotation, Separation techniques, Flocculation, Spray irrigation, Wastewater renovation, Wastewater irrigation.

The two types of wastewater generated by Sun City Eggs of Clermont, Florida (one from the rinsing of eggs, the other from plant clean-up) were originally transported to a landfill by tanker truck. The current treatment and effluent disposal system involves land disposal of wastewater by spray irrigation onto an on-site field. The wastewater is pre-screened to remove eggshells and other debris. The liquid waste is collected in the existing below-ground storage tank. The waste is pumped from the tank into an electroflotation unit for treatment. The treated liquid waste is stored in surface lagoons, while the treatment system sludge is collected on sludge-drying beds. The treated liquid wastewater is pumped from the lagoon to the spray-field for disposal at a rate of 0.033 inches per acre per day. The new system has been mechanically sound. No ponding of the effluent has occurred at the surface. No significant impact on water table quality is expected, due to the high percolation rates and extremely low dosing rate. (See also W88-01725) (Geiger-PTT)
W88-01732

ASPECTS OF PHOSPHOGYPSUM WASTE DISPOSAL,
Steffen, Robertson and Kirsten, Inc., Vancouver (British Columbia).
A. Smith, I. Hutchison, and J. Caldwell.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 108-115, 1 tab, 3 ref.

Descriptors: *Waste disposal, *Groundwater pollution, *Clays, *Linings, *Calcium sulfate, Fate of pollutants, Path of pollutants, Fertilizers, Leaching, Leachates, Solid waste disposal, Waste management, Case studies.

The chemistry and groundwater pollution potential of phosphogypsum wastes, the process of chemical attack on clay liner materials, and changes in groundwater quality due to seepage are examined. The loss of even relatively small volumes of phosphogypsum slurry liquid could have a major impact on a receiving water. Hydrofluoric acid from natural weathering may cause serious damage to natural materials used to line tailings impoundments. Three case histories are presented to illustrate many of the potential problems associated with phosphogypsum waste disposal. In the first case the phosphogypsum disposal facility was sited on highly-weathered, igneous rocks. Series of subsurface trenches and pumping sumps were installed to return leachates to either the tailings impoundment or to the plant for use in re-slurrying phosphogypsum waste. The trenches incorporated acid-resistant geofabric and 19-40 mm inert stone. An artificial membrane was used to line the base of subsequent extensions to the disposal facility. In the second case some seepage was observed on the surface along the toe wall of a phosphogypsum disposal facility after summer rainfall. Phosphogypsum disposal was discontinued on those areas of the impoundment where contamination was shown to be more prevalent and a new extension was constructed that allowed deposition to be stopped completely on the older parts of the impoundment. The new extension utilized an artificial membrane liner to eliminate seepage to the groundwater. At the third plant, selection of a site for phosphogypsum disposal was limited to an area of low-lying marshland. In order to use the site as a landfill, the phosphogypsum was neutralized prior to deposition on the impoundment. The impoundment is underlain by thick alluvial clays of high plasticity that effectively limited downward seepage into groundwater. Facilities are porvided to control and collect seepage water from the impoundment for return to the plant. (See also W88-01725) (Geiger-PTT)
W88-01733

REMEDIAL ACTION ASSESSMENT FOR HAZARDOUS WASTE SITES VIA NUMERICAL SIMULATION,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W88-01735

PREVENTION AND CONTAINMENT OF HAZARDOUS/TOXIC MATERIALS SPILLS IN DEPARTMENT OF DEFENSE STORAGE AND HANDLING AREAS,
Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD.
D. R. Bowlus, and T. M. White.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 149-159, 4 fig, 9 ref.

Descriptors: *Hazardous materials, *Water pollution prevention, *Cleanup, *Monitoring, *Model studies, *Water pollution treatment, *Industrial wastes, *Waste management, Waste disposal, Path of pollutants, Toxins, Environmental protection, Water pollution control, Decontamination, Safety, Training, Oil spills.

The key elements of the U.S. Department of Defense's spill prevention program for hazardous materials are discussed. To identify potential spills, an in-house survey, spill reports by employees, and assistance/advice surveys are recommended. Installation personnel should develop and write standard operating procedures which set forth the proper method of performing each operation involving the handling and/or transfer of haardous or toxic materials. An emergency response plan that outlines methodology to be used in coping with spill situations should be readily available to all the approporiate installation personnel. Several levels and types of training are required for spill prevention. These include overview, specific intensive, and on-job training. Aspects of facility design, containers, security, and special prevention devices for hazardous waste management are also discussed. Containment of spills of solids usually requires only collection by shovelling or vacuuming. The best control of liquid spills is by stopping the release of the spill at its source. To contain petroleum spills, fuel tanks are diked with an earth-base usually lined with a sprayed concrete, polyethylene, or clay. Drainaige of the entire dike area flows to a sump with a valve. Another device being tested is an imbiber bead gravity drain protection system placed in the bottom of the sump. (See also W88-01725) (Geiger-PTT)
W88-01736

TOXIC ORGANIC BEHAVIOR IN SLUDGE-AMENDED SOILS,
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5B.
W88-01737

LONG-TERM IMPACTS OF INDUSTRIAL WASTE CODISPOSAL IN LANDFILL SIMULATORS,
SCS Engineers, Inc., Covington, KY.
J. Walsh, G. Vogt, R. Kinman, and J. Rickabaugh.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 166-187, 12 fig, 4 tab. EPA Contract No. 68-03-2758.

Descriptors: *Landfills, *Waste disposal, *Simulation analysis, *Industrial wastes, *Fate of pollutants, *Leachates, Leaching, Decomposition, Viruses, Sludge disposal, Hydrogen ion concentration, Infiltration rate, Soil temperature, Waste characteristics, Monitoring, Solid waste disposal.

The solid waste decomposition and contaminant release of various types of simulated landfills were examined under the following variables: water infiltration rates, initial water addition, pH buffer addition, sewage sludge addition, selected industrial waste addition, and different air and sourrounding soil temperatures. The survivability of poliovirus in landfills, and the ability to replicate monitoring data from two test cells constructed and operatred under similar conditions were also examined. The following characteristics of the leachate from each similator were studied in an on-going monitoring program: quantity, pH, alkalinity, volatile acids, COD, TOC, total P, total Kjeldahl N, and total solids. Results showed that leachate strength decreases as a function of moisture throughput. Studies of sewage sludge addition suggested that municipal solid waste landfills can probably receive sludge loadings of up to 4% by dry weight with no significant impact on leachate quality. The addition of Calcium carbonate appeared to elevate leachate pH levels for much of the monitoring period, while having no significant impact on alkalinity and volatile acid concentrations. The duplicate cells gave different leachate concentration histories, presumably due to the variability of solid waste. Leachate histories for the six codisposal cells containing municipal and industrial wastes were indistinguishable from those of the control cells. Certain elevated heavy metals tended to leach out quickly to levels encountered in control cells. Industrial waste influences on leachate were always less than one order of magnitude, suggesting that codisposal of certain industrial wastes within municipal refuse may be a viable land disposal option. (See also W88-01725) (Geiger-PTT)
W88-01738

HEAVY METALS IN DRILLING MUDS: SEQUENTIAL EXTRACTABILITY AND EFFECT OF A SOLIDIFICATION PROCESS,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 5B.
W88-01739

FLY ASH DISPOSAL IN A LIMESTONE QUARRY: HYDROGEOCHEMICAL CONSIDERATIONS,
Detroit Edison Co., MI.
D. Leonard, D. F. Unites, and J. O. Kebe.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 199-218, 4 fig, 5 tab, 7 ref.

Descriptors: *Fly ash, *Solid waste disposal, *Quarries, *Land disposal, *Water pollution sources, *Leaching, *Path of pollutants, Groundwater pollution, Geohydrology, Selenium, Geochemistry, Model studies, Hydrologic models, Leachates, Trace elements, Adsorption, Water quality, Limestone.

Fly ash is presently being deposited in a mechanically dewatered limestone quarry. Saturation of the fly ash with groundwater will occur in the future, with subsequent leachate generation and movement into the surrounding limestone. Studies were performed to predict such possible future occurrences. These studies included: A review of previous site data, bench scale work to understand the fly ash-groundwater-limestone interactions and transport modeling. A review of site conditions indicated a neutral fly ash and groundwater that contained high levels of dissolved natural salts. Fly ash and groundwaters batch extractions resulted in elevated levels of some trace elements, in particular Se. A series of batch extractions produced a 'worst-case' leachate, with elevated Se concentrations. Subsequent studies using site limestone and leachate containing Se indicated a removal of the Se from solution, most likely through absorption. Transport modeling incorporating data generated in the bench-scale work, then estimated leachate movement. This modeling predicted that the quarry would not have negative effects on water quality in the area. (See also W88-01725) (Author's abstract)
W88-01740

BENNETT'S QUARRY: A CASE STUDY OF AN IMMEDIATE REMOVAL OF PCB WASTES UNDER SUPERFUND,
Weston (Roy F.), Inc., Northbrook, IL. SPER Div.
K. Stimpson, S. Springer, and R. Lillich.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 219-232, 2 fig, 1 tab.

Descriptors: *Quarries, *Polychlorinated biphenyls, *Decontamination, *Cleanup operations, *Waste disposal, Leaching, Fate of pollutants, Water pollution effects, Leachates, Fluvial sediments, Surveys, Industrial wastes, Waste dumps, Case studies.

Bennett's Quarry near Bloomington, Indiana, was contaminated by polychlorinated biphenyls (PCB) after the site was used as a waste dump for old electrical parts. The Indiana State Board of Health contacted the U. S. EPA Region V to assist in a detailed site assessment and cleanup effort. Soil discoloration and vegetation stress was noted over large portions of the site. PCB concentrations ranged from 26-38% in on-site soils and averaged 160 ppm in stream sediments bordering the site. An Emergency Action and Removal Plan was prepared as a result of the imminent threat to human health. The plan involved removal and disposal of exposed capacitors and associated contaminated soils; execution of extent of contamination studies including aerial photography, soil sampling, and magnetometer/ground-penetrating radar surveys; and, constructing a cap on the site with low permeability. The decontamination effort was completed within 7 wk with expenditures of $222,000 of Superfund monies. The experienced gained in this case study should prove valuable in future cleanups of this type. (See also W88-01725) (Geiger-PTT)
W88-01741

CONTAINMENT OF IRON SULFATE FROM ABANDONED PICKLE LIQUOR PONDS INVESTIGATION, FEASIBILITY STUDY DESIGN AND CONSTRUCTION,
Donohue and Associates, Inc., Sheboygan, WI.
M. L. Crosser, J. E. Underwood, and J. G. Emanuel.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 223-252, 28 fig, 13 ref.

Descriptors: *Sulfates, *Metal-finishing wastes, *Decontamination, *Waste disposal, *Feasibilty studies, Industrial wastes, Waste management, Liquid wastes, Evaluation, Project planning, Cleanup, Cost analysis, Leaching, Path of pollutants, Groundwater pollution, Iron compounds, Design criteria.

The A. O. Smith Automotive Division located in Milwaukee, Wisconsin, uses the sulfuric acid pickling process to clean steel prior to metal finishing. The company operated spent pickle liquor treatment ponds on company property for over 30 yr. The ponds were covered with fill material in 1968 when the company began transporting the spent pickle liquor to the Milwaukee Metropolitan Sewerage District Plants for use in precipitating phosphorus from wastewater. Elevated concentrations of iron and sulfate in a storm sewer adjacent to the pond alerted company officials that the material from the former pond was moving in the groundwater. A study was undertaken in 1982 to accomplish the following objectives: determine the amount, composition and distribution of waste material below the surface at the site; assess the need to undertake remedial action to remove or contain the waste; and evaluate alternatives for remedial action, if required. The field study using borings, wells and ground penetrating radar and laboratory investigations found that remedial action was appropriate and that containment was environmentally acceptable and cost-effective. A slurry wall with a soil/bentonite backfill together with a clay cap followed by bituminous pavement were designed and constructed. (See also W88-01725) (Author's abstract)
W88-01742

LIQUID DISPOSAL, INCORPORATED: A $2.2 MILLION SUPERFUND IMMEDIATE REMOVAL ACTION,
Weston (Roy F.), Inc., Northbrook, IL. SPER Div.
S. Springer, G. Watkin, J. Dourjalian, and R. Powers.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 253-266, 3 fig.

Descriptors: *Liquid wastes, *Industrial wastes, *Waste disposal, *Decontamination, *Project planning, Environmental effects, Soil contamination, Fly ash, Waste management, Hazardous materials, Cleanup, Public health, Incineration.

Liquid Disposal, Incorporated (LDI), near Utica, Michigan, operated a liquid waste incinerator from 1967 to 1982. The facility incurred repeated violations of air and water permits and was ultimately forced to close after the accidental death of two employees. Deteriorating conditions on the site resulted in the initiation of three immediate removal cleanups under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). The latest action, conducted in a six month period in 1983, was the largest single CERCLA-funded immediate removal to date. It resulted in expenditures of approximately $2.2 million from the Hazardous Substance Response Trust Fund and effected a total surface removal of hazardous materials. Site conditions addressed by the cleanup included: a waste oil lagoon containing 1.8 million gallons of PCB and solvent-contaminated liquids; a scrubber ash lagoon containing 250,000 gallons of contaminated water and sludge; an assortment of 1,800 drums containing known and unknown wastes including shock-sensitive, water-reactive, explosive and flammable materials; bulk storage tanks containing flammable liquid and PCB contaminated oils; contaminated surface soils containing high concentrations of Cr; and, the presence of 2,150 cu yd of scrubber fly ash containing a variety of organic compounds. The technical aspects of each removal task are outlined, and the health and environmental threats posed by the site are addressed. Cooperation between federal, state, and local agencies is essential for the successful completion of a short-term, multi-million dollar, immediate action cleanup under Superfund. (See also W88-01725) (Author's abstract)
W88-01743

SITE SAFETY AT THE MIDDLETOWN ROAD REMOVAL,
Geo/Resource Consultants, Inc., Washington, DC.
G. M. Davidson.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 267-282, 6 fig.

Descriptors: *Safety, *Waste dumps, *Landfills, *Decontamination, *Environmental effects, Project planning, Solid waste disposal, Waste management, Cleanup, Waste disposal, Heavy metals, Monitoring, Soil contamination, Design criteria, Training.

The Middletown Road Dump, near Annapolis, Maryland was used as a landfill since the early 1900's. When a portion of the site was contaminated with heavy metals and surface waters and an aquifer outcrop showed low levels of metals, the EPA allocated $359,000 for removal of the contaminants. The cleanup plan took 6 months and involved removing buried hazardous materials containers and contaminated soils, grading and stabilizing the site to mitigate runoff, and installing groundwater monitoring wells. The responsibilities of the site's safety officier during the decontamination procedures are listed. Major risks to workers were exposure to chemicals, physical injury from accidents, and heat stress. A contamination reduction area was designed for decontaminating workers, their clothing and equipment. Decontamination of heavy equipment was time consuming due to the trapping of contaminated soil in tire treads. Measures for mitigating heat stress among workers during the cleanup and worker training programs are discussed. (See also W88-01725) (Geiger-PTT)
W88-01744

MONITORING AN IMPLEMENTED REMEDIAL ACTION,
Conestoga-Rovers and Associates, Waterloo (Ontario).
F. A. Rovers, and E. A. McBean.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 283-295, 2 fig, 7 tab.

Descriptors: *Solid waste disposal, *Waste dumps, *Decontamination, *Monitoring, *Mathematical models, Leaching, Evaluation, Cleanup, Groundwater pollution, Path of pollutants, Surface waters, Water pollution prevention, Model studies, Waste disposal, Organic compounds, Arsenic.

The change in both groundwater concentrations and chemical loadings of arsenic (As), orthonitroaniline (ONA), and 1,1,2-trichloroethane (TCE) to an adjacent river from a waste dump are examined by comparing pre-and post-monitoring conditions arising from implementation of remedial measures to the site. The remedial work involved placing a clay cap over the landfill, securing a riprap around the toe of the capped area to prevent erosion, grading of the area to enhance runoff and reduce infiltration, planting of a weather-resistant ground cover, and installing fencing to limit access. Monitoring data were examined by mechanistic mathematical models and by statistical characterization of data. Results showed that there was a continuing decrease in concentration levels in the groundwater for all three chemicals, with particularly notable decreases in As and ONA, arising from implementation of the remedial actions. A decrease in chemical loadings to the adjacent river were also noted, especially for ONA and TCE. Statistical interpretation of the monitoring data, as opposed to the use of mechanistic mathematical models was the most effective means of characterizing the impact of the remedial actions at the site. (See also W88-01725) (Geiger-PTT)
W88-01745

SOIL--AN UNCERTAIN MEDIUM FOR WASTE DISPOSAL,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5B.
W88-01746

HAZARDOUS WASTE DISPOSAL IN CRYSTALLINE ROCK,

Minnesota Waste Management Board, Crystal.
M. P. Katsoulis.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 312-324, 5 fig, 8 ref.

Descriptors: *Hazardous materials, *Underground waste disposal, *Illinois, *Bedrock, *Waste management, Path of pollutants, Leaching, Cost analysis, Case studies, Geohydrology, Geophysics, Rocks, Permeability coefficient, Maintenance.

Crystalline bedrock offers more of a potential to achieve permanent isolation of buried hazardous wastes than any other disposal technologies currently available. In selecting a site for crystalline rock disposal, the following characteristics are important: low rockmass porosity and hydraulic conductivity, flow field of gentle groundwater gradient, geomechanical stability of the rockmass, and geochemical stability of the rock formation from interaction with the various types of stored wastes. The Waste Management Board was directed by the 1980 Minnesota Legislature to select a site within the state for final burial of hazardous wastes and to analyze alternative methods of disposal suitable for use in Minnesota. Four sites were selected, one of which was subjected to detailed field surveys that confirmed its promising nature for waste disposal. Cost analyses showed that the cost of using a deeprock facility for storage of wastes should be fairly comparable to a near ground surface storage system. Not only would a deep rock burial system meet the waste management industry's goal of storage and reuse, but it would also offer the benefit of covertability to a secure, low-maintenance facility for isolation of the residual wastes from the biosphere. (See also W88-01725) (Geiger-PTT)
W88-01747

AVOIDING FAILURE OF LEACHATE COLLECTION SYSTEMS AT HAZARDOUS WASTE LANDFILLS,
Little (Arthur D.), Inc., Cambridge, MA. Hazardous Waste Management Unit.
J. M. Bass.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 335-351, 1 fig, 5 tab, 11 ref. EPA Contract No. 68-03-1822.

Descriptors: *Leachates, *Landfills, *Hazardous materials, *Drainage systems, *Land disposal, Waste management, Path of pollutants, Waste disposal, Leaching, Design criteria, Maintenance, Monitoring, Corrosion control, Liquid wastes, Chemical precipitation, Decontamination.

Failure of leachate collection systems is expected to be a problem in the operation of hazardous waste disposal facilities, just as failure of drainage systems has been a problem at agricultural sites. The principal failure mechanisms include sedimentation, precipitation of biological, chemical and biochemical materials, and mechanisms which do not involve clogging, including pipe deterioration due to chemical attack or corrosion, differential settling, and exceeding design capacity. Operating experience with leachate collection systems indicates that all of the principal failure mechanisms have occurred in the field, although experience with chemical and biochemical precipitation is limited. In a survey of twenty waste disposal facilities which had leachate collection system problems, twelve experienced problems attributable to errors in design, construction or operation. The remaining eight experienced problems that could likely have been avoided through system maintenance. Designing to avoid failure includes careful pipe location, redundancy, allowing for maintenance requirements and addressing specific failure mechanisms. Construction must involve adequate quality assurance and may require special construction techniques. Operation to avoid failure includes regular inspection and system maintenance to find and address problems before they become too serious. (See also W88-01725) (Author's abstract)
W88-01749

SANITARY LANDFILL LINERS - AN OVERVIEW OF REGULATORY REQUIREMENTS AND ENGINEERING PRACTICES,
Land and Lakes Co., Park Ridge, IL.
J. T. Ambroso.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 363-372, 3 fig, 2 tab, 2 ref.

Descriptors: *Sanitary landfills, *Design criteria, *Linings, *Leachates, *Clays, Permeability, Landfills, Waste management, Waste disposal, Land disposal, Regulations, Path of pollutants, Leaching, Groundwater pollution.

In 1975, a survey was made of the types of liners used at 61 municipal sanitary landfill sites throughout the United States. Of these sites, 34 used compacted clay liners, 26 employed polyvinyl chloride liners, 8 used asphaltic-type liner and 3 utilized other types of man-made liners. The regulatory requirements for clay liners in sanitary landfills and how these compare with standard engineering practices are discussed. Public concern over groundwater contamination by landfill leachate has prompted state legialators and environmental agencies to establish regulations or guidelines governing liner design and construction. A survey of state agencies showed that 18 states had no established requirements for clay liners at landfills, 12 states have adopted guidelines and 20 states have adopted regulations governing the use of clay liners. Of the 32 states that have specific requirements, 23 had design criteria while 9 had non-degradation standards. Twenty-two of the 23 states that employed design standards used liner thickness and permeability as their sole criterion of effectiveness. Only one state, California, specified additional requirements regarding the composition of the clay liner. The mineralogy of clay liners as well as other site specific physical factors should be examined before liner thickness and permeability are assigned. Site specific factors that are recommended for use in determining design permeability and thickness of clay liners are detailed. (See also W88-01725) (Author's abstract)
W88-01750

DIFFUSIONAL TRANSPORT OF HAZARDOUS WASTE LEACHATE ACROSS CLAY BARRIERS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W88-01751

DEVELOPMENT AND APPLICATION OF BATCH ADSORPTION PROCEDURES FOR DESIGNING EARTHEN LANDFILL LINERS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5B.
W88-01752

EVALUATION OF THE PERFORMANCE OF FOUR CLAY-LINED LANDFILLS IN WISCONSIN,
Wisconsin Dept. of Natural Resources, Madison. Bureau of Solid Waste Management.
M. E. Gordon, P. M. Huebner, and P. Kmet.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 399-460, 21 fig, 15 tab, 18 ref, append.

Descriptors: *Linings, *Clays, *Leachates, *Landfills, *Wisconsin, *Path of pollutants, Case studies, Monitoring, Design criteria, Waste disposal, Waste management, Groundwater pollution, Water pollution prevention.

The use of clay liners as a means of leachate containment at landfills has recently received considerable attention in the literature. Several authors have indicated potential concerns with the ability of a clay liner to provide an acceptable level of groundwater portection. While some of these concerns appear valid, only limited data has been presented on the performance of existing clay-lined landfills. This paper is intended to help fill this information gap by providing a detailed performance evaluation of four of the many operational clay-lined landfills in Wisconsin. The sites selected for detailed evaluation are four of the better documented and monitored clay-lined landfills in Wisconsin and together, represent over 20 years of operational experience. Included is a summary of each site's geologic setting, major design features, construction and operational experience and an evaluation of overall site performance. Using this information, supplemented with data and observations from several of the other sites of similar design, it is concluded clay liners can provide an adequate means of leachate containment at landfills disposing of municipal and many industrial wastes. (See also W88-01725) (Author's abstract)
W88-01753

CAPABILITY MAPPING FOR SANITARY LANDFILL USING COMPUTER GRAPHICS,
Wisconsin Univ.-Green Bay.
B. D. J. Johnston, and R. D. Stieglitz.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 461-471, 1 fig, 26 ref.

Descriptors: *Sanitary landfills, *Computer models, *Mapping, *Land use, *Site selection, Hydrologic data collections, Geohydrology, Computer programs, Case studies, Graphical methods, Graphical analysis, Waste management, Project planning.

The methodology of using capabiltiy analysis combined with computer graphics for a landfill siting study performed in Oconto County, Wisconsin is described. The use of two computer graphics packages (IMGRID, developed by the Tennessee Valley Authority, and SYMAP, developed by the Harvard Laboratory of Computer graphics and Spatial Analysis) lends speed and flexibility to the method. Capability analysis was performed using IMGRID (Information Management on a Grid Cell System). Data collected on the study area's physical environment were converted to a form understandable to IMGRID. The computer graphics package, SYMAP was utilized for contouring point data. Base maps were selected according to their availability and applicability to the landfill siting process. The well log data was put into map form by a contouring routine performed by the SYMAP computer graphics package. Once all the data was in continuous or map form, it was converted to a form understandable to IMGRID. After the data was entered into IMGRID, the data elements were evaluated for sanitary landfills. The evaluation was performed with the aid of a decision matrix. Data elements in the decision matrix were weighted according to their capability of supporting, withstanding, or tolerating a sanitrary landfill. In this manner, many scenarios can be easily examined taking into account difference of opinions, and specific project needs or constraints. (See also W88-01725) (Geiger-PTT)
W88-01754

DEMONSTRATION OF LANDFILL GAS ENHANCEMENT TECHNIQUES IN LANDFILL SIMULATORS,
SCS Engineers, Inc., Covington, KY.
G. Vogt, J. Walsh, W. Held, R. Kinman, and J. Rickabaugh.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 472-494, 14 fig, 10 tab.

Descriptors: *Sanitary landfills, *Simulation analysis, *Leachates, *Sludge utilzation, *Nutrients, Recycling, Municipal wastes, Monitoring, Moisture content, Waste recovery.

Various techniques to enhance gas production from sanitary landfills were applied to 16 landfill simulators. These techniques included accelerated moisture infiltration; elevated moisture content; leachate recycle; addition of buffers, nutrients, and sludges; and elevated refuse temperatures. Each test cell contained approximately 380 kg of municipal solid waste. All simulators were constructed in February 1980. Numerous chemical and physical parameters have been measured to determine leachate and gas quantity and quality. Operations

and monitoring have now progressed into the fifth year, and four years of data are available for presentation. Results through completion of the third monitoring year have been presented in prior papers. This paper presents results available through four years, as of the end of January, 1984. Leachate and gas analytical results indicate that enhancement has been best achieved by the following variables: sludge addition, leachate recycle, accelerated moisture infiltration, and elevated moisture content. Additions of buffers and nutrients have had some small beneficial impacts. (See also W88-01725) (Author's abstract)
W88-01755

RECENT DEVELOPMENTS IN METHANE RECOVERY FROM MUNICIPAL LANDFILLS,
Bernard M. Baruch Coll., New York. Dept. of Public Administration.
E. B. Berenyi, and R. N. Gould.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 495-505, 10 tab, 8 ref.

Descriptors: *Landfills, *Municipal wastes, *Methane, *Waste recovery, *Recycling, Waste disposal, Waste management, Solid waste disposal, Cost analysis, Fuel, Surveys.

The extent of methane recovery from municipal landfills in the United States, the types of processes being used, problems being encountered and costs of this technology are examined. A telephone survey was made of all operating methane recovery facilities in the United States as well as those in conceptual or advanced planning stages of development. Results of the survey confirmed the growth of this technology application. While production of medium to high Btu gas yields was practiced at the greatest percentage of existing facilities surveyed, the trend among planned facilities is toward production of a low Btu gas yield. Capital costs are decreased when a low Btu gas is produced and there is no substantial decrease in potential users for the fuel. Existing plants have a somewhat larger output of gas in relation to capacity. Over one-half the facilities surveyed use or will use the gas produced to generate electricity on-site. Nearly all the methane recovery facilities sampled have secured a contract for the sale of their electricity or gas product or anticipate the signing of such a contract. Private sector ownership dominates over public ownership of methane gas facilities; this is made possible by the low capital costs of constructing methane gas facilities. About half of the facilities are situated on active landfills and the other half on inactive landfill sites. Slightly under two-thirds of the 75 facilities surveyed are located on landfills owned and operated by the public sector. There appears to be a greater willingness of public sector landfills to accept methane recovery facilities. (See also W88-01725) (Geiger-PTT)
W88-01756

BALING: A CASE STUDY,
Antigo City Engineer, WI.
R. B. Brobst.
IN: Seventh Annual Madison Waste Conference Municipal and Industrial Waste, September 11-12, 1984. 1984. p 506-513, 4 fig, 2 tab.

Descriptors: *Landfills, *Compaction, *Dewatering, *Baling, *Waste management, Solid waste disposal, Compressibility, Case studies, Waste disposal, Waste recovery, Recycling, Cost analysis.

When the city of Antigo, Wisonsin was running out of landfill space, it decided to try baling its solid wastes to increase the life of the limited landfill space it had left. Baling is a method of compressing the refuse with hydraulic pressure prior to placing it in a sanitary landfill. Depnding on the pressure used, the bale may require some form of straping to retain its shape and density. The city decided, after reviewing the alternative, that baling required the least time to implement. By using the Logemann Baler, cover requirements were reduced by 90% and compaction more than doubled. The city also utilizes the baler for recycling cardboard, aluminum, and plastics. (See also W88-01725) (Geiger-PTT)
W88-01757

METHOD AND APPARATUS FOR DISPOSING OF DRILLING MUDS AND WASTES GENERATED DURING WELL DRILLING OPERATIONS AND FOR PLUGGING AND ABANDONING THE WELL,
G. D. Allard.
U.S. Patent No. 4,429,746; February 7, 1984. 11 p, 10 fig. Official Gazette of the United States Patent Office, Vol 1039, No 1, p 119-120, February 7, 1984.

Descriptors: *Water pollution prevention, *Groundwater pollution, *Patents, *Drilling mud, *Oilfield wastes, *Drilling equipment, *Waste disposal, *Disposal wells, *Mud, Well casings, Pump wells, Pumping, Cements, Well seepage.

Well drilling muds and waste fluids from drilling operations are disposed into the wells, which are then plugged and abandoned without the need for renting a rig. When it is undertaken in young soft rock formations, the process involves a surface casing containing a check valve, which allows fluids to be pumped through it from the surface and which also may prevent fluids from rising up in the well from below. The surface casing is coupled at about ground level to a disposal, plugging, and abandoning tree through which fluids, mud, and cement can be introduced. When the process is undertaken in areas where seepage back into the well is unlikely, the check valve or packer need not be used. (Cremmins-AEPCO)
W88-01777

METHOD FOR STRENGTHENING SOFT SOIL,
Chiyoda Chemical Engineering and Construction Co. (Japan).
For primary bibliographic entry see Field 2G.
W88-01779

SYSTEM AND METHOD FOR DISPOSAL OF NONCONDENSABLE GASES FROM GEOTHERMAL WELLS,
J. T. Kuwada.
U.S. Patent No. 4,632,601; December 30, 1986. 6 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1073, No 5, p 2625, December 30, 1986.

Descriptors: *Patents, *Geothermal resources, *Hydrogen sulfide, *Disposal wells, *Wastewater disposal, Wastewater treatment, Reservoirs, Brines, Industrial wastes, Injection wells.

Noncondensable gases, including hydrogen sulfide gas, derived from geothermal fluids are safely disposed by injecting them into a well bore along a path separate from the one in which wastewater (spent brine) is injected into the well. The length of the path along which the gases flow corresponds to a depth in the well, which provides a static head pressure equal to the gas partial pressure required to dissolve the gases into the wastewater. Dissolution of the gases prevents venting to the atmosphere. The noncondensable gases are returned to the reservoir formation in the same chemical form in which they were produced; they are not required to be subjected to sophisticated chemical processing that creates waste products requiring special handling and disposal; and hydrogen sulfide is not converted to a form that may decompose in the reservoir and precipitate solids that could plug or impair the permeability of the injection zone. Because the noncondensable gases are injected into the wastewater through a separate tubing string set inside a well bore, wastewater only need be pumped to the pressure required to inject and dispose of it in the well bore itself. (Cremmins-AEPCO)
W88-01780

PROCESS OF SAFELY DISPOSING OF WASTE MATERIALS,
G. Heide, and H. Wagner.
U.S. Patent No. 4,456,400; June 26, 1984. 5 p, 4 tab, 1 ref. Official Gazette of the United States Patent Office, Vol 1043, No 4, p 1565, June 26, 1984.

Descriptors: *Patents, *Waste disposal, *Coal, *Water pollution control, Solid waste disposal, Sand, Clays, Slurries, Titanium, Industrial wastes, Acids.

Waste materials or those dissolved or suspended in aqueous liquids are mixed with brown coal ash and, if desired, water, to form a homogeneous mixture having the consistency of a pulp or freely flowable slurry. The proportions of the ingredients of the mixture are selected so that the mixture hardens to a virtually water impermeable material. The alkaline substance consists of brown coal ash which is available in large quantities in powerplants. The process may be used to bind various waste materials so that they will not pollute the environment. In a preferred embodiment of the process, waste acid from the solubilization of titanium-containing ores for the production of titanium dioxide pigments is bound as a waste material. To obtain a solid end product that is compact and virtually water-impermeable, a homogeneous mixture is formed, which contains the waste acid and the brown coal ash in a predetermined weight ratio. The mixture is stirred until a pulp is obtained. The mixed pulp consisting of brown coal ash and waste acid may be further compacted by mechanical treatment. (Cremmins-AEPCO)
W88-01782

STORAGE POND,
British Nuclear Fuels Ltd., Warrington (England).
E. Watson, and E. Hunter.
U.S. Patent No. 4,451,173; May 29, 1984. 3 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1042, No 5, p 2046, May 29, 1984.

Descriptors: *Radioactive waste disposal, *Waste disposal, *Patents, *Ponds, *Hazardous materials, *Underwater, *Water storage, *Radioactive wastes, Leakage, Water pollution control, Trenches, Soil contamination, Impervious membranes, Polymers, Concretes.

A pond for the storage of hazardous materials, such as radioactive wastes, comprises a concrete base having upper and lower impervious membranes, which extend uninterrupted beneath the floor of the pond. The edges of the membranes lead into a trench surrounding the base so that any leakage through the floor of the pond is directed into the trench. If a fault or leak appears in the upper membrane, any seepage of liquid will be contained by the lower membrane and channelled into the trench. The membranes can be made of a robust plastics material, for example polyethylene. The membrane may also be sandwiched between layers of bituthene or similar bedding material. (Cremmins-AEPCO)
W88-01783

DISCHARGE OF GASES FROM SUBMARINE DESALINATION PLANTS,
Mannesmann A.G., Duesseldorf (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W88-01789

PROCESS AND APPARATUS FOR RECOVERING USABLE WATER AND OTHER MATERIALS FROM OIL FIELD MUD/WASTE PITS,
Romec Environmental Research and Development, Inc., College Station, TX.
For primary bibliographic entry see Field 5D.
W88-01795

LAND APPLICATION OF SLUDGE IN SAN DIEGO,
Nolte (George S.) and Associates, Sacramento, CA.
R. W. Crites, and D. Richard.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 8, p 774-780, August 1987. 2 fig, 10 tab, 10 ref.

Descriptors: *Land disposal, *Recreation demand, *Land development, *California, *San Diego,

Sludge, Urbanization, Municipal wastes, Costs, Regulations, Sludge drying, Long-term planning, Waste water disposal.

The city of San Diego must move its sludge drying operation from Fiesta Island by 1987, due to the planned development of the island as a water-oriented recreation facility. A master plan has been prepared for sludge management over the next 25 years. Considerable interest has been expressed in the beneficial use of sludge for agriculture, land reclamation, and distribution of compost. The recommendation is that the sludge reuse program have multiple options that include distribution of compost as well as agricultural land application, land reclamation, and reuse in sod farming. The article contains a detailed description of the current sludge treatment facilities of the San Diego Metropolitan Sewer System. It discusses the specific characteristics of the sludge currently being produced, the regulatory restraints on land application that are pertinent in California, site selection for new uses of the sludge and the relative costs of the new plan. (Airone-PTT)
W88-01826

USE OF A VACUUM FILTRATION TECHNIQUE TO STUDY LEACHING OF INDIGENOUS VIRUSES FROM RAW WASTEWATER SLUDGE,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W88-01841

PASSAGE OF WASTE DISCHARGES THROUGH BLOCKS WITH VERTICAL UNITS,
For primary bibliographic entry see Field 5B.
W88-01901

REDUCTION OF MICROBIAL INDICATORS AND VIRUSES IN A CYPRESS STRAND,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5B.
W88-01947

STUDIES ON THE ECOLOGICAL EFFECTS OF VARYING THE SIZE OF FISH PONDS LOADED WITH MANURES AND FEEDS,
Asian-Pacific Regional Research Center for Integrated Fish Farming, Wuxi (China).
For primary bibliographic entry see Field 8I.
W88-02039

CULTURE OF MULLET SPECIES IN PONDS RECEIVING IRON CRUSH EFFLUENTS AT EL-BAHARIA OASIS, EGYPT,
General Authority for Fish Resources Development, Cairo (Egypt).
For primary bibliographic entry see Field 8I.
W88-02041

FEEDING PROCESSED HATCHERY WASTES TO POULTRY,
Kuwait Inst. for Scientific Research, Safat. Agro-Production Dept.
M. A. Ilian, and A. J. Salman.
Agricultural Wastes AGWADL, Vol. 15, No. 3, p 179-186, 1986. 6 tab, 9 ref.

Descriptors: *Farm wastes, *Manure, *Feeds, *Waste disposal, *Poultry, *Dehydration, Chemical analysis, Proteins, Calcium, Amino acids, Minerals, Nutrients, Growth, Eggs.

Waste from a local hatchery was processed by cooking it with water at a ratio of 2 waste to 1 water, and then dehydrating the product ('processed hatchery waste,' PHW). PHW was subjected to proximate, mineral, and amino acid analyses; it was found to contain 22.8% crude protein, 21.48% true protein, 22.64% Ca, and 2706 kcal/kg metabolizable energy. The product was incorporated at 2.5% and 5.0% levels in broiler rations and at 4%, 8%, and 12% in laying hen diets as a substitute for soyabean meal, meat meal, and ground limestone. In the broiler trials, body weight gains, feed consumption, and feed efficiency were comparable for birds on all diets. The optimal inclusion level of PHW in broiler rations is around 2.5%. In the laying hens trial, body weights, egg production rates, feed consumption and efficiency, and egg size were not adversely affected by including PHW in diets. (Author's abstract)
W88-02066

EFFECT OF RATE AND TIME OF APPLICATION OF NITROGEN IN COW SLURRY ON GRASS CUT FOR SILAGE,
Agricultural and Food Research Council (England). Bristol Lab.
R. J. Unwin, B. F. Pain, and W. N. Whinham.
Agricultural Wastes AGWADL, Vol. 15, No. 4, p 253-268, 1986. 9 tab, 9 ref.

Descriptors: *Fertilizers, *Nitrogen, *Cattle, *Slurries, *Grasses, *Silage, *Manure, Soil amendments, Agricultural chemicals, Feeds, Pastures, Growth, Farms, Ammonium, Nitrates, Farm wastes.

The availability of the nitrogen in cow slurry for grass growth has been investigated by a number of workers, and values from 14% to 84% have been reported for the season after application. Results are presented for seven field experiments undertaken in southern England on four different farms in the harvest years 1977-1979. Spring and summer slurry applications were 25-30% as effective as ammonium nitrate in promoting dry matter yield of ryegrass swards; winter applications were somewhat less at around 15%. When combined with applications of ammonium nitrate, the average response was similar, but there were appreciable differences in responses between sites. The apparent recovery of slurry nitrogen in herbage was 13% averaged over all treatments. (Author's abstract)
W88-02069

ONE SOLUTION TO THE PROBLEM OF HANDLING AND TREATING SLURRY FROM A PIG FATTENING HOUSE,
National Inst. of Agricultural Engineering, Silsoe (England). Farm Buildings Div.
For primary bibliographic entry see Field 5D.
W88-02070

LABORATORY METHODS FOR ESTIMATING AVAILABLE NITROGEN IN MANURES AND SLUDGES,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
G. M. Chescheir, P. W. Westerman, and L. M. Safley.
Agricultural Wastes AGWADL, Vol. 18, No. 3, p 175-195, 1986. 2 fig, 8 tab, 27 ref.

Descriptors: *Laboratory analysis, *Nitrogen, *Manure, *Analytical methods, *Sludges, *Incubation, *Fertilizers, Estimating, Soil amendment, Farm wastes, Nitrates, Cattle, Hogs, Accumulation, Poultry, Wastewater, Soil types, Chemical analysis, Kinetics, Ammonia, Wastewater, Municipal wastewater, Denitrification, Nitrogen removal, Nitrogen cycle, Land disposal, Sludge disposal.

A soil incubation experiment was conducted to determine nitrate N accumulation rates and available N (AAN) values for stored liquid manures from dairy cattle and swine, poultry manures, and a municipal sewage sludge applied to Norfolk and Cecil soils. Potentially available N (PAN) was also estimated by chemical tests. The resulting PAN values were compared to the AAN values from the soil incubation study. The rates in which NO3-N accumulated in soils treated with waste were described using first-order kinetics. The rate constants were highest for soils treated with poultry manure which contained high initial concentrations of ammonia N and rapidly mineralizable organic N. The lowest rate constants were for soils treated with municipal sludge which contained low concentrations of NH3-N. Incubation tests showed significant reductions in inorganic N in the first two weeks, suggesting immobilization and/or denitrification or NH3-N volatilization. After 26 weeks' incubation, AAN varied with waste type and soil type, being from 40% to 67% of total Kjeldahl N applied to a Norfolk sandy soil and from 17% to 38% for a Cecil sandy loam. (Author's abstract)
W88-02072

REVIEW OF FULL-SCALE ANAEROBIC DIGESTION IN CHINA,
Polytechnic of Wales, Pontypridd. Dept. of Mechanical and Production Engineering.
For primary bibliographic entry see Field 5D.
W88-02073

IRRIGATION OF PRIMARY TREATED AND ANAEROBICALLY TREATED MEAT-PROCESSING WASTES ONTO PASTURE: LYSIMETER TRIALS,
Meat Industry Research Inst. of New Zealand, Hamilton.
J. M. Russell.
Agricultural Wastes AGWADL, Vol. 18, No. 4, p 257-268, 1986. 5 tab, 18 ref.

Descriptors: *Irrigation, *Meat processing industry, *Industrial wastes, *Anaerobic digestion, *Primary wastewater treatment, *Lysimeters, *Land disposal, Wastes, Biodegradation, Biological wastewater treatment, Digestion, Wastewater treatment, Moisture meters, Soil types, Pastures, Nitrates, Nitrogen, Effluents, Crop yield.

Primary treated and anaerobically treated meat-processing wastes were irrigated onto pot lysimeters containing Horotiu sandy loam (Entic Dystrandept) and a ryegrass/clover sward. Four effluent application rates were used: 0, 500, 1,000, and 2,000 kg N/ha/yr. For primary and anaerobically treated effluent, pasture production was maximal at 2,000 kg and 1,000 kg N/ha/yr, respectively. Herbage from lysimeters receiving anaerobically treated effluent contained much higher concentrations of nitrate-nitrogen than that from lysimeters receiving primary treated effluent. Health problems may result when ruminants feed on high-nitrate materials. Based on 'safe' nitrate levels in the herbage, the upper loading limit would be about 500 kg N/ha/yr for anaerobically treated effluent, and about 1,000 kg N/ha/yr for primary treated effluent. (Author's abstract)
W88-02074

EFFECT OF FERTILIZER, CHICKEN MANURE AND DAIRY MANURE ON TIMOTHY YIELD, TISSUE COMPOSITION AND SOIL FERTILITY,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Renewable Resources.
P. R. Warman.
Agricultural Wastes AGWADL, Vol. 18, No. 4, p 289-298, 1986. 4 tab, 18 ref.

Descriptors: *Fertilizers, *Poultry, *Manure, *Cattle, *Crop yield, *Timothy, *Tissue analysis, *Fertility, Grasses, Quebec, Clays, Soil types, Nutrients, Accumulation, Carbon, Nitrates, Potassium, Copper, Heavy metals, Soil amendment.

The effect of dairy manure, chicken manure, and fertilizer was assessed on timothy yield, tissue composition, and soil fertility from 1980 to 1982 using field plots in clay soil in Quebec. Plots treated with chicken manure at 33.6 wet t/ha (CM2) outyielded all other treatments and produced the highest uptake of all the essential nutrients analyzed. Treatments influenced the organic C, nitrate-N, Bray P2, NH4OAc-extractable K, and DTPA Cu content of the soil with the CM2 treatment producing the highest extractable K and Cu content. Treatments of chicken manure at 16.8 wet t/ha (CM) and dairy manure increased organic C compared to fertilizer and control treatments. Based on the plant and soil results, the use of CM2 or dairy manure (89.6 wet t/ha) rates of application of manure are recommended for timothy production. (Author's abstract)
W88-02075

INFLUENCE OF DOMESTIC SEWAGE ON GROWTH AND NITROGEN FIXATION OF AZOLLA PINNATA R. BR.,
Burdwan Univ. (India). Dept. of Botany.
M. Chakrabortty, and D. Kushari.
Aquatic Botany AQBODS, Vol. 24, No. 1, p 61-68, March 1986. 1 fig, 3 tab, 27 ref.

Descriptors: *Wastewater disposal, *Wastewater, *Plant growth, *Azolla, *Ferns, *Nitrogen fixation, *Orthophosphates, *Seasonal variation, Anabaena, Cyanophyta, Phosphorus, Biomass, Algae, Culturing techniques, Carbon, Nitrogen, Tissue analysis.

The use of sewage effluent was assessed as a cheap medium in which to culture Azolla pinnata for optimization of growth and nitrogen fixation. Biomass production of Azolla cultured in sewage effluents under full sunlight correlated closely with the changes of orthophosphate phosphorus in the medium. It was highest (13.18 g/m) in August as opposed to 6.34 g/m in January, though the environmental influence was remarkable. Phosphorus contents in different media, particularly in one receiving a higher quantity of sewage effluents, gradually increased to 20.30 micrograms/l in January, reaching a maximum in May (37.60 micrograms/l), followed by a gradual decline with a further rise in August (32.70 micrograms/l). The seasonal variation in phosphorus content of the medium was closely associated with the carbon, phosphorus, and nitrogen contents of plant tissue, as well as the heterocyst frequency of the algal symbiont, Anabaena azollae. The respective increases in nitrogen, carbon, and phosphorus contents of plant tissue in micrograms/l during August were 39.80, 280.00, and 2.20, compared with values of 28.20, 245.00, and 1.50 during January, while the heterocyst frequencies were 15.96 and 10.92, respectively. (Author's abstract)
W88-02078

USE OF SHEEP MANURE AS NUTRIENT WITH FISH FEED IN POND FISH POLYCULTURE IN TRANSKEI,
Transkei Univ., Umtata (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 8I.
W88-02094

GROWTH OF THE CHINESE GRASS CARP CTENOPHARYNGODON IDELLA FED ON CABBAGE WASTES AND KIKUYU GRASS,
Transkei Univ., Umtata (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 8I.
W88-02095

UTILISATION OF CHICKEN OFFAL IN THE PRODUCTION OF THE AFRICAN SHARP-TOOTH CATFISH CLARIAS GARIEPINUS IN THE TRANSKEI,
Transkei Univ., Umtata (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 8I.
W88-02096

UTILIZATION OF VINASSE EFFLUENTS FROM AN ANAEROBIC REACTOR,
Cooperative Regional dos Productores de Acucar de Alagoas, Maceio (Brazil).
For primary bibliographic entry see Field 5D.
W88-02117

PROCEDURE FOR DETERMINING POTENTIAL GAS QUANTITIES IN AN EXISTING SANITARY LANDFILL,
Dynatech Corp., Cambridge, MA.
M. J. Laquidara, A. P. Leuschner, and D. L. Wise.
Water Science and Technology WSTED4, Vol. 18, No. 12, p 151-162, 1986. 9 fig, 3 tab, 10 ref.

Descriptors: *Waste disposal, *Analytical methods, *Sanitary landfills, *Gas yield, *Data processing, Landfills, Field tests, Feasibility studies, Data interpretation, Drawdown, Municipal wastes, Solid wastes.

A procedure for determining potential gas quantities in existing landfills was developed and a case study based on this procedure is presented. Over the last five years Dynatech R/D Company was involved in performing feasibility studies to determine potential gas quantities in existing landfills. The data collected during this period was reduced and plotted. Using the reduced data base, a systematic procedure for determining the extent of decomposition and decay rate coefficients is presented. Finally, the entire procedure for determining gas potential in an existing landfill is performed for a case study. The case study results are verified using field drawdown tests. (Wood-PTT)
W88-02119

ANAEROBIC DIGESTION OF MUNICIPAL SOLID WASTES,
Sao Paulo Univ. (Brazil). Escola Politecnica.
W. Schmidell, A. M. Craveiro, C. S. Peres, Y. S. Hirata, and R. F. Varella.
Water Science and Technology WSTED4, Vol. 18, No. 12, p 163-175, 1986. 7 fig, 1 tab, 8 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Solid wastes, *Waste disposal, *Municipal wastes, Solid waste disposal, Wastes, Digestion, Sludge, Sao Paulo, Brazil, Hydrogen ion concentration, Organic loading, Retention time, Methane, Sanitary landfills.

The present state of municipal solid waste (MSW) disposal in Brazil is discussed with emphasis on the particular situation in the City of Sao Paulo. Future trends of the anaerobic digestion approach for this residue are indicated. Some representative results from studies of anaerobic digestion of MSW mixed with primary sewage sludge are presented. The studies were conducted using agitated reactors of 2 or 8 liter capacity which were continuously operated at 35 C in the pH range 6.8 to 7.2. The studies included: start-up of reactors, MSW to sewage sludge ratio, organic loading rate, and hydraulic retention time. The results indicate interest in achieving anaerobic digestion of MSW in the presence of sewage sludge using reactors with high solids content. (Wood-PTT)
W88-02120

CO-DISPOSAL OF MUNICIPAL REFUSE AND INDUSTRIAL WASTE SLUDGE IN LANDFILLS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
F. G. Pohland, and J. P. Gould.
Water Science and Technology WSTED4, Vol. 18, No. 12, p 177-192, 1986. 8 fig, 6 tab, 6 ref.

Descriptors: *Combined waste disposal, *Waste disposal, *Industrial wastes, *Domestic wastes, *Landfills, Wastes, Sludge, Heavy metals, Sludge disposal, Metals, Leachates, Waste load, Waste stabilization, Toxicity.

The results of a 2-year pilot-scale investigation on the codisposal of heavy metal sludge with municipal refuse, under the influence of leachate containment and recycle, are used to illustrate and describe the effects of various metal loadings on the normal progress of waste stabilization and to assess associated assimulative capacity. Evidence of metal precipitation as sulfides or hydroxides and subsequent removal by filtration and sorption in the refuse mass was demonstrated. Conversely, the mobilization of heavy metals was shown to be enhanced by complexation with humic-like substances which also tended to reduce overall toxic effects. Whereas, high heavy metal loadings exhibited a clear inhibitory effect, a definite capacity for assimilation and acclimation at low to moderate levels was established. (Author's abstract)
W88-02121

COMPOSTING AND THE LIMITING FACTOR PRINCIPLE,
Cal Recovery Systems, Inc., Richmond, CA.
C. G. Golueke, and L. F. Diaz.
Biocycle BCYCDK, Vol. 28, No. 4, p 22-25, April 1987.

Descriptors: *Composting, *Limiting factors, *Waste disposal, Microbial degradation, Biodegradation, Economic aspects, Biological treatment, Limiting nutrients, Microorganisms, Growth, Populations, Oxygen, Aeration, Temperature, Moisture content, Carbon, Nitrogen.

The principle of the limiting factor is useful because the efficiency and performance of a biologically-based composting system are directly dependent on the well-being of the microorganisms on which that system relies, regardless of the degree of technological advancement. The biological factor in lowest supply that limits the growth and activity of the organisms under consideration is the limiting factor. Sound economics and problem prevention depends on designing and operating a system such that no operational, nutritional, environmental or any other factor is exhausted or becomes deficient and thereby the limiting one. The five essential factors that are key design features in recent compost technology were discussed; they are (1) suitable microbial population or populations, (2) available oxygen for aeration, (3) proper temperature, (4) sufficient moisture content, and (5) adequate available carbon to maintain the appropriate carbon/nitrogen ratio. (Wood-PTT)
W88-02122

TURNAROUND IN SUSSEX COUNTY,
P. F. Cerenzio.
Biocycle BCYCDK, Vol. 28, No. 4, p 26-28, April 1987. 1 fig.

Descriptors: *Sussex County, *Sludge disposal, *Composting, *Sludge, *Odors, *New Jersey, *Waste disposal, Sludge drying, Wastewater facilities, Aeration, Computers, Automation, Process control.

After startup in July 1984 of the sludge/septage composting facility in Sussex County, New Jersey, nuisance odors became evident although it was determined that the facility was properly operated according to previously developed methods. Composting operations were suspended in February 1985 while extensive research on composting methods and strategies was conducted resulting in new, vastly improved composting technology. The renovations performed on the existing facility which included enclosures, increased aeration, improved aeration control systems and computerized operation were described. Operation resumed in June 1986 with excellent operating efficiency, substantially reduced odor which rarely moves outside the site confines, decreased processing time (originally 50-100, now 15 days prior to screening), and improved product. The present system configuration is detailed. (Wood-PTT)
W88-02123

UPTAKE OF CADMIUM AND ZINC BY CORN ON SLUDGE-TREATED SOILS,
Cornell Univ., Ithaca, NY.
L. M. Naylor, M. Barmasse, and R. C. Loehr.
Biocycle BCYCDK, Vol. 28, No. 4, p 37-41, April 1987. 2 fig, 4 tab, 11 ref.

Descriptors: *Path of pollutants, *Waste disposal, *Sludge utilization, *Plant growth, *Data acquisition, *Cadmium uptake, *Zinc uptake, *Corn, Heavy metals, Sludge, Field tests, On-site tests, Greenhouse tests, Crop yield.

Plant growth and cadmium and zinc uptake by field corn grown in a greenhouse in pots were compared with corn grown in field plots to establish the consistency of the data. Statistical relationships between metal uptake by corn grown in the two environments were determined, the divergencies of such uptake by a crop which is less sensitive than most to soil metal were investigated, and the growth of a crop with a high nutrient uptake in pots and the field was assessed. The sludge used for this study was a heat-dried, waste-activated sludge produced in Milwaukee and marketed commercially as a lawn fertilizer. It was determined that location of the tests (field versus greenhouse pot) can affect the results. Therefore, results from

greenhouse experiments are not directly comparable to those from field studies. Experimental differences noted were : (1) confinement of roots to the relatively small pot volume, and (2) lower fertility available in pots. Greatly accentuated metal uptake rates were not observed in the this study using field corn which is a known non-accumulator. However, significant differences were evident in the corn fodder concentrations of zinc and cadmium demonstrating that, even for a non-accumulator crop, the use of results from greenhouse pot studies to project field results is inappropriate. (Wood-PTT)
W88-02124

GREENING OF BLUE MOUNTAIN,
Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
W. E. Sopper, and J. M. McMahon.
Biocycle BCYCDK, Vol. 28, No. 4, p 47-51, April 1987. 1 tab.

Descriptors: *Sludge disposal, *Municipal wastewater, *Vegetation regrowth, *Fertilizers, *Blue Mountain, *Reforestation, *Revegetation, Industrial wastes, Fly ash, Sludge, Pennsylvania, Field tests, Heavy metals, Soil contamination, Seedlings, Trees, Grasses, Legumes.

The north slope of Blue Mountain in Pennsylvania has become a barren area due to emissions of zinc, cadmium, lead, and sulfur dioxide from a zinc smelting plant, extensive logging, frequent fires, and erosion. Natural revegetation has been hampered primarily by the high zinc concentrations found in the surface mineral soil and in the organic detritus present in the area. Because it is impossible for grass, legume and tree species to germinate directly on the soil highly contaminated by the metals and lacking nutrients and microorganism populations, a growing medium was deposited on top of the contaminated soil. Locally available sludge and fly ash were mixed in various ratios and the mixtures were evaluated both in a greenhouse study and in field trials. The application rates and the types of seedlings used were detailed. Preliminary results showed that all hardwood species except red maple had a survival rate of over 73% in all sludge-fly ash mixtures and that the highest survival of all tree species was found on the mixture with two parts by volume of sludge to one part fly ash. Results from the chemical analysis of leaves for nitrogen, potassium, phosphorus, and trace metals are presented. Foliar analyses of various grasses and legume species show that nutrient and cation concentrations were adequate and that there were no great differences among the species or among the sludge-fly ash mixtures. Based on the evaluations of the vegetation responses after the first growing season, it was concluded that sludge-fly ash mixtures are successful in facilitating the establishment of vegetation on Blue Mountain. Monitoring over the next several years will show if it is possible to continue to use municipal sludge as an organic fertilizer on the mountain rather than disposing of it in a landfill. (Wood-PTT)
W88-02126

ANALYSIS OF EPA GUIDANCE ON COMPOSTING SLUDGE: PART IV - FACILITY DESIGN AND OPERATION,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 5D.
W88-02127

SLUDGE MANAGEMENT IN THE UNITED KINGDOM,
WRC, Inc./Guarino Engineers Ltd., Philadelphia, PA.
J. Davis, and D. Garvey.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 20, No. 3, p 11-15, May-June 1987. 1 fig, 5 tab.

Descriptors: *Sludge management, *Sludge disposal, *Wastewater treatment, *Sludge, *Waste disposal, Sludge utilization, Sludge conditioning, Sludge drying, Dewatering, United Kingdom, United States, Comparison studies, Landfills, Incineration, Operating costs, Costs, Land reclamation.

Treatment and disposal options for sludge in the United Kingdom including agricultural use, sea dispersal, landfill, and incineration are detailed and compared with sludge disposal in the United States. It was found that the major uses and disposal options for sewage sludge in the two countries are similar although the regulations set forth by the USA are much more conservative. Also, in the USA, sludge management practices are much more in the public forum which results in fewer disposal sites, fewer suitable land application sites, and difficulties in siting incinerators due to public opposition. These factors affect the operating costs. Increased environmental pressures in both countries on sea disposal, tighter constraints on landfilling, and increase in incineration of sludge and its use in agriculture and land reclamation were noted. If the economics become favorable, manufacture of soil conditioners and fuel products may become more widespread. (Wood-PTT)
W88-02130

SORPTION/DESORPTION OF VARIOUS INORGANIC AGENTS ON OIL SHALE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
D. M. Cowher, G. D. Boardman, and A. N. Godrej.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 203-211, 4 fig, 4 tab, 20 ref.

Descriptors: *Sorption, *Desorption, *Inorganic compounds, *Oil shale, *Land disposal, *Path of pollutants, Fate of pollutants, Leaching, Temperature, Arsenic, Cadmium, Fluorine, Iron, Hydrogen ion concentration.

Aqueous solutions in most natural systems contain mixtures of many organic and inorganic agents. In a landfill where co-disposal is practiced, shale will come into contact with many solutes, some produced by the leaching of constituents from the shale itself and others introduced by the process waters. Some materials might be adsorbed and/or precipitated, thereby reducing the concern for potential contamination of surface waters or aquifers. On the other hand, solutes in process waters might pass through the shale readily, cause elution of other substances from the shale, or interact with shale constituents to produce even more hazardous substances. THere are a number of different scenarios for the sorption/desorption (S/D) of substances which makes it very difficult to predict how solutes alone and in mixtures will behave. The research presented here was undertaken to provide some insights into the S/D behavior of various inorganic substances on four shales. Retort temperatures and porosity values of the various shales studied appeared to have a significant effect on the quantity of inorganic constituents that leached from the spent shales. Most of these constituents were flushed from the columns during elution trials in the first two to eight pore volumes of effluent. The shales retorted at lower temperatures, which also had higher porosity values, exhibited greater sorption capacities for As, Cd and F than the raw shale and shale retorted at higher temperatures. As, Cd, and Fe were removed to below detection limits in most of the sorption trials. Removals of Cd and Fe were effected predominantly through precipitation of the metals at the relatively high pH of the shale eluents. (See also W88-02132) (Lantz-PTT)
W88-02154

IMPACTS OF MULTI-JURISDICTIONAL AGREEMENTS AND EFFLUENT DISPOSAL BY CITRUS IRRIGATION ON THE DEVELOPMENT OF AN INDUSTRIAL WASTE PRETREATMENT PROGRAM,
Boyle Engineering Corp., Orlando, FL.
For primary bibliographic entry see Field 6E.
W88-02160

INSTITUTIONAL BARRIERS TO LAND TREATMENT OF METAL FINISHING WASTEWATERS,
North Central, Inc., Palatine, IL.
For primary bibliographic entry see Field 5D.
W88-02187

ILLEGAL LIQUID INDUSTRIAL WASTE SITE CLEAN-UP AND RESTORATION,
Ontario Ministry of the Environment, Toronto (Ontario). Environmental Approvals and Project Engineering Branch.
For primary bibliographic entry see Field 5G.
W88-02197

CONTAMINANT FIXATION PROCESS,
Environmental Protection Polymers, Inc., Hawthorne, CA.
R. W. Telles, S. L. Unger, and H. R. Lubowitz.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 685-691, 11 fig, 1 tab, 15 ref.

Descriptors: *Contaminant fixation, *Waste disposal, *Water pollution prevention, Plastics, Hazardous wastes, Radioactive wastes, Landfills, Polyethylene.

Fixation technology is required to render residues from hazardous waste volume-reduction processes safe for final disposal. Of particular concern is the management of low-level radioactive pollutants and non-destructible industrial contaminants. To this end, this investigation concerns the concept and the fabrication of novel plastic modules of fixed concentrated wastes. The stresses of a landfill. Laboratory-scale modules have been thoroughly investigated and the experimental findings and process cost estimates provide the basis for scale-up of modules to a commercially viable size 50-gallon ones. Modules are characterized by cores holding up to 90% (by weight) contaminants in polyolefimic matrices encased by 1/4-inch thick, seamless jackets of high density polyethylene. The jackets are formed by fusion and impregnation of resin powder onto the surfaces of the cores. The modules have been employed to secure a broad spectrum of hazardous wastes such as electroplating residues, pesticides, water-soluble toxic salts, arsenic-bearing filter cake and rad-waste beads, powders, and salts. High performance stabilization of contaminants for their final disposal was realized by this surface encapsulation process. The novel plastic modules of concentrated wastes stemming from the process were compact, safely transportable and stable versus simulated, long-term environmental stresses. Cost benefits accrue because the process employs commodity resins, assures reproducible fabrication of high quality products, tolerates a broad spectrum of contaminant types without chemically pretreating them, and adds nil volume to that of the hazardous consignments. The full-scale management of low-level radioactive wastes for final disposal is addressed first by the process. Radioactive ion-exchange resins and salts are contaminants that are difficult to manage by state-of-the-art means. In full-scale operation this process will manage them in 50-gallon waste modules. (See also W88-02132) (Lantz-PTT)
W88-02200

EVALUATION OF IRRIGATION MANAGEMENT PROCEDURES FOR GEOTHERMAL EFFLUENT,
Idaho Water Resources Research Inst., Moscow.
For primary bibliographic entry see Field 3C.
W88-02268

LAND APPLICATION OF MUNICIPAL WASTEWATER: IMPACTS OF WATER RIGHTS AND LAND-USE CONTROLS,
Virginia Water Resources Research Center, Blacksburg.
W. E. Cox.
Available from the National Technical Institue Service, Springfield, VA 22161, as PB87 218202/AS, price codes: A06 in paper copy, A01 in micro-

fiche. Virginia Water Resources Research Center, Blacksburg, Technical Completion Report, May 1983. 116 p. OWRT Project No. B-076-VA(1).

Descriptors: *Land disposal, *Municipal wastewater, *Water rights, *Land use, Wastewater disposal, Wastewater treatment, Water law, Riparian rights, Local governments, Regulations.

Law relevant to water rights and land use controls is analyzed in order to create a better understanding of the nature and significance of institutional impediments to the land application technique of municipal wastewater disposal. Land application in some cases offers an environmentally acceptable and cost-effective means of disposing of municipal wastewater, but its feasibility is affected by several institutional constraints: water rights and land use controls are two of the potentially most significant impediments. Water rights issues may arise in connection with implementation of land application projects due to the likelihood of significant hydrologic modifications. If land application is adopted as a replacement for a conventional system of wastewater treatment and discharge to a body of surface water, return flow patterns will be modified to the possible detriment of other water users. Both the appropriative and the riparian doctrines, the principal doctrines of water law in effect in the United States, contain provisions to limit adverse effects of this type. In addition, land application projects may alter the flow of diffused surface water, and special bodies of law impose constraints on such changes. Land use controls are potentially significant due to land application's need for substantial amounts of land and its capacity to produce adverse effects on surrounding land. One significant type of land use control consists of governmental regulations such as local zoning ordinances. These regulations become especially important whenever a locality desires to establish a land application project outside its own political boundaries. A second applicable type of land use control consists of privately initiated tort actions that may be directed toward the operator of a land application project in response to such problems as odors, water contamination, or flooding. (Lantz-PTT)
W88-02276

PREDICTION OF SURFACE RUNOFF WATER QUALITY FROM BLACK ROCK HARBOR DREDGED MATERIAL PLACED IN AN UPLAND DISPOSAL SITE,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. G. Skogerboe, C. R. Lee, R. A. Price, D. Brandon, and G. Hollins.
Available from the National Technical Information Service, Springfield, Virginia. 22161. Miscellaneous Paper D-87-1, March 1987. Final Report. 35 p, 10 fig, 4 tab, 24 ref.

Descriptors: *Surface runoff, *Path of pollutants, *Water quality, *Black Rock Harbor, *Land disposal, Dredging, Waste disposal, Fate of pollutants, Heavy metals, Zinc, Copper, Cadmium, Nickel, Manganese, Lysimeters, Suspended solids, Chromium, Filtration, Waste treatment.

The US Army Engineer Waterways Experiment Station (WES) Rainfall Simulator-Lysimeter System was developed to predict surface runoff water quality from dredged material placed in upland environments. Initial laboratory tests on dredged material placed in lysimeters showed that as the dredged material dried and oxidized, physicochemical changes occurred which changed the concentrations and form of contaminants found in surface runoff. These tests predicted that, initially, concentrations of suspended solids (SS) usually would be elevated and heavy metals would be poorly soluble and bound to the SS. As the material was dried and oxidized, SS concentrations in the runoff would decrease, and heavy metals such as copper, cadmium, zinc, nickel, and manganese would increase in solubility. Dredged material collected from the upland disposal site was sampled and used in additional laboratory lysimeters at the WES. A series of rainfall simulations was applied to both the upland field plots and the laboratory lysimeters containing the dredged material using the WES Rainfall Simulator. Surface runoff samples were collected and analyzed for SS and for Cd, Cu, Zn, Ni, Mn, and chromium. Filtered heavy metal concentrations were not statistically different between the two laboratory lysimeter tests and the field tests for either the wet, anaerobic or the dry, oxidized sediment or dredged material. Unfiltered concentrations of metals in surface runoff from the dredged material were less than concentrations in runoff from the initial sediment during the wet, anaerobic stage. Results of this study showed that placement of Black Rock Harbor dredged material in an upland environment would allow physicochemical changes to occur that would significantly increase the solubility of Cd, Cu, Ni, Zn, and Mn. Filtered metal concentrations in surface runoff from dry, oxidized sediment would be statistically equal to unfiltered metal concentrations, indicating increased solubility of metals after dredged material was placed in an upland disposal site. (Lantz-PTT)
W88-02279

MANAGEMENT OF HAZARDOUS WASTE: TREATMENT/STORAGE/DISPOSAL FACILITIES,
For primary bibliographic entry see Field 5D.
W88-02325

REGIONAL HYDROGEOLOGIC RESEARCH IN THE PALO DURO BASIN FOR NUCLEAR-WASTE REPOSITORY SITING,
Texas Univ. at Austin. Bureau of Economic Geology.
A. R. Dutton, C. W. Krietler, and T. C. Gustavson.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 24, No. 2, p 221-225, May 1987. 2 fig, 26 ref. DOE Contract DE-AC97-83WM46651.

Descriptors: *Underground waste disposal, *Radioactive wastes, *Waste disposal, *Geohydrology, *Groundwater movement, *Aquifers, *Path of pollutants, Evaporites, Dissolution, Geochemistry, Salts.

Regional hydrologic and geochemical studies indicate that groundwater flow through an evaporite confining system in the Palo Duro Basin, Texas Panhandle, and salt dissolution at the top of the evaporite confining system are important issues for siting a nuclear-waste repository in bedded salt. Data that are needed to resolve these issues include ages and sources of groundwater in the salt-dissolution zone and in aquifer units overlying the evaporite confining section to determine the history of the salt-dissolution zone; permeability, hydraulic head, and water density in the upper part of the confining section to determine groundwater flow velocity; and hydrogeologic and geochemical parameters of the aquifer units and the confining system to assess the potential for migration of stored waste. (Author's abstract)
W88-02331

GEOTECHNICAL CONSIDERATIONS FOR THE DESIGN OF AN EXPLORATORY SHAFT FACILITY FOR A NUCLEAR WASTE REPOSITORY IN DEAF SMITH COUNTY, TEXAS,
Woodward-Clyde Consultants, Houston, TX.
R. L. Lentell.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 24, No. 2, p 235-245, May 1987. 5 fig, 3 tab, 8 ref.

Descriptors: *Underground waste disposal, *Radioactive wastes, *Waste disposal, *Geohydrology, *Geochemistry, *Groundwater movement, *Aquifers, Texas, Utah, Salts.

Area-wide geologic studies have been conducted in six states to identify sites for detailed site characterization studies, and ultimately the construction of the nation's first high level nuclear waste disposal facility. Host rock types in the respective states under consideration include basalts in Washington state, tuffs in Nevada, bedded evaporites (salts) in Utah and Texas, and diapiric salt in Mississippi and Louisiana. An exploratory shaft facility (ESF) is an integral part of the detailed site characterization activities mandated by the Nuclear Waste Policy Act of 1982. One of the primary objectives of the exploratory shaft is to provide access to the target repository horizon so that detailed in situ testing can be performed to evaluate site suitability for repository construction, materials characterization, model validation, etc. In addition, the ESF will provide a means of evaluating construction conditions and applicable methods for the potential repository, and for characterizing the geologic and hydrologic conditions of the materials overlying the target horizon. Seven salt sites in four states have been considered for ESF preliminary designs. While salt has several advantages for waste isolation, such as its impermeability, thermal and viscoplastic properties, etc., it also presents some unusual design and construction problems. The solubility and visco-plastic nature of salt requires special lining designs and construction to isolate and control water inflow and to avoid excessive stress build-up due to the long term deformations (creep) of salt. Other major geotechnical factors involved in the design of the ESF, and of special interest to Texas are the protection of fresh water aquifers (particularly the Ogallala and Dockum formations in the Texas Panhandle), ground stabilization and groundwater control during shaft sinking (anticipated to require ground freezing methods through the upper 1,000 ft of overburden at the Texas sites), seismic stresses, in situ stresses, groundwater conditions in non-fresh water aquifers, etc. Exploratory borings will be drilled for each shaft at a salt site during ESF Final Design activities. The boring program will include comprehensive borehole and laboratory testing for the purpose of verifying or modifying design assumptions, as required. (Author's abstract)
W88-02332

EFFECT OF ASH DISPOSAL PONDS ON GROUNDWATER QUALITY AT A COAL-FIRED POWER PLANT,
Wisconsin Univ.-Madison. Water Resources Center.
G. V. Simsiman, G. Chesters, and A. W. Andren.
Water Research WATRAG, Vol. 21, No. 4, p 417-426, April 1987. 3 fig, 5 tab, 26 ref.

Descriptors: *Waste disposal, *Fly ash, *Disposal ponds, *Groundwater pollution, *Water quality, Monitoring, Water analysis, Plumes, Flow, Aquifers, Heavy metals.

The impact of fly and bottom ash disposal ponds on groundwater quality was investigated at the coal-fired Columbia Power Plant at Portage, Wis. Groundwater sampling was conducted utilizing a network of piezometers and multilevel wells located at various cross-sections of the ash disposal facility. Analyses were performed for 16 major and minor elements, pH and conductivity. Data for a 3-yr monitoring program established the existence of large B, Na and SO4 plumes in the groundwater system surrounding the ash disposal area. Substantial amounts of B, Na and SO4 were present in the plume and portions were discharged into an adjacent wetland as the plumes moved with groundwater flow. The secondary fly ash settling pond was the major source of B and SO4, while the main source of Na was from previous releases to the aquifer from the use of Na2CO3 to condition fly ash to enhance removal of SO2 from flue gas by electrostatic precipitation. Movement into the groundwater of heavy metals such as Cu and Zn was not observed and their concentrations are likely attenuated in the pond. (Author's abstract)
W88-02340

SILVICULTURAL APPLICATION OF ALUM SLUDGE,
South Central Connecticut Regional Water Authority, New Haven.
R. J. Grabarek, and E. C. Krug.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 6, p 84-88, June 1987. 15 fig, 4 tab, 13 ref.

Descriptors: *Alum sludge, *Sludge disposal, *Waste disposal, *Water pollution effects, *Silvi-

culture, Leachates, Toxicity, Plants, Growth, Trees, Costs, Sludge, Alum, Aluminum.

Various properties of two types of alum sludge were investigated to determine whether silvicultural application was an appropriate method of disposal. These particular sludges did not produce any undesirable leachates, values of which were within limits set out in the Connecticut Public Health Code, nor did they produce aluminum toxicity in plants - even those grown in pure sludge. Alum sludge binds phosphorus, making it unavailable or slowly available to plants and thus possibly limiting plant growth and even physiologically stressing plants. The results of analyses indicated that limited applications of this material on forested land would most likely not measurably affect tree growth. Land application of alum sludge appears to hold promise as a low-cost disposal alternative. (Author's abstract)
W88-02396

EFFLUENT QUALITY VARIATIONS IN RELATION TO WATER REUSE FOR IRRIGATION,
Kuwait Univ., Safat. Dept. of Civil Engineering.
M. F. Hamoda.
Journal of Environmental Science and Health (A) JESEDU, Vol. 22, No. 2, p 161-187, February 1987. 9 fig, 2 tab, 10 ref. Kuwait Univ. Research Council Grant EV. 021.

Descriptors: *Effluents, *Impaired water use, *Irrigation, *Water quality, *Activated sludge, Wastewater, Water use, Statistics, Nutrients, Raw water.

Performance data from an activated sludge wastewater treatment plant were examined to evaluate variations in effluent quality used for irrigation. Frequency and moving average statistical analyses were performed on daily plant data collected during one year. It has been found that secondary-treated effluent quality can, for at least 50% of the time, satisfy the requirements for irrigation waters concerning solids, organics and nutrients levels. Effluent quality was influenced primarily by influent (raw) wastewater characteristics and was not highly variable except for suspended solids content. Filtration and chlorination processes are recommended in order to ensure more adequate and reliable effluent for irrigation. (Author's abstract)
W88-02401

ASSESSMENT OF THE INTERACTIONS OF METALS AND NITRILOTRIACETIC ACID IN SOIL/SLUDGE MIXTURES,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
K. Garnett, P. W. W. Kirk, J. N. Lester, and R. Perry.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 1, p 55-69, May 1987. 8 fig, 1 tab, 45 ref.

Descriptors: *Nitrilotriacetic acid, *Water chemistry, *Wastewater treatment, *Detergents, *Heavy metals, *Sludge, *Solutions, Speciation, Wastewater, Organic compounds, Solubility.

The effects of nitrilotriacetic acid (NTA) from phosphorus-free detergents on solution phase forms of Cu, Mn, Ni, and Zn in digested sewage sludge and a soil/sludge mixture were investigated. Gel filtration chromatographic analysis indicated that Cu and possibly Ni were maintained in solution by association with a soluble, high molecular weight organic fraction; Mn solubility was due to the presence of unbound inorganic species and soluble Zn was distributed equally between the two forms. Speciation of the metals in the solution phase of the soil/sludge mixture generally reflected that of the sludge. However, the total amount of soluble Mn in the soil/sludge mixture was approximately 25 times greater than in the sludge and was attributed to heavy metal induced release of indigenous soil Mn. Increases in the quantities of soluble Ni and Zn in both the sludge and the soil/sludge mixture following equilibration with 40 mg/L NTA were due to conversion of solid phase forms to soluble metal-NTA complexes. The preferential complexation of NTA with Cu already present in soluble organic forms resulted in a change in speciation without a corresponding increase in solubility. The importance of changes in speciation with regard to potential metal mobility and bioavailability within sludge-amended soil is discussed. (Author's abstract)
W88-02478

5F. Water Treatment and Quality Alteration

STUDY OF SALINE WATER USE AT THE ETIWANDA GENERATING STATION,
For primary bibliographic entry see Field 3A.
W88-01611

TWO ADJACENT PIPE DIAMETERS AT THE OPTIMAL SOLUTION IN THE WATER DISTRIBUTION NETWORK MODELS,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Industrial Engineering and Management.
O. Fujiwara, and D. Dey.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1457-1460, August 1987. 2 fig, 1 tab, 12 ref.

Descriptors: *Pipes, *Pipe diameters, *Conveyance structures, *Water distribution, *Model studies, Costs, Mathematical models, Optimization, Economic aspects, Water conveyance.

In the study of optimization models for the design of water distribution networks, most of the literature has either indicated or explicitly claimed that at the optimal solution each link will consist of at most two pipe segments with adjacent diameters. The necessary and sufficient conditions are that a given set of pipe diameters is in an optimal solution, and a special case shows that the adjacency property holds if and only if pipe costs are a strictly convex function of a power of pipe diameters. (Wood-PTT)
W88-01678

DEFLUORIDATION OF BLACK CREEK AQUIFER WATERS,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
T. M. Keinath.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 229480/AS. Price codes: A07 in paper copy, A01 in microfiche. South Carolina Water Resources Research Institute, Clemson. Publication No. 125, June 1987. 113 p, 56 fig, 16 tab, 45 ref. Contract No. 14-08-0001-G1251. Project No. USGS G1251-03.

Descriptors: *Defluoridation, *Activated alumina, *Fluorides, *Adsorption, *Ion exchange, *Water treatment, Adsorbents, Resins, Groundwater, Aquifers, Drinking water, Potable water, Anions, Ionic interference, Water supply, Water costs, Water quality, Black Creek Aquifer, South Carolina.

Because waters of the Black Creek Aquifer, located in Horry and Georgetown Counties of South Carolina, contain concentrations of fluoride that exceed the maximum contaminant level (1.6 mg/l) allowed by the National Interim Primary Drinking Regulations, water utilities in the region must either seek an alternate supply or must defluoridate. Those that have no option but to defluoridate will likely do so through the application of activated alumina, an exchange adsorbent. This study showed that the presence of chloride, sulfate, and bicarbonate anions in the Black Creek Aquifer waters did not affect, in a statistical sense, the fluoride exchange adsorption capacity of activated alumina for the range of concentrations found in the aquifer. In contrast, the pH of the water (hydroxide ion concentration) dramatically affected the exchange adsorption capacity of the activated alumina. This effect was effectively described by an empirical regression. The exchange adsorption capacity of the activated alumina used in the study also was seen to decrease, due to abrasion with each exhaustion/regeneration cycle. A 30% decrease in capacity was observed when steady-state had been attained after two or three cycles. Finally, the optimum pH for minimizing the cost of operating a defluoridation facility was found to lie in the range of 6 to 7. (Keinath-WRRI)
W88-01769

METHOD OF REVERSE OSMOSIS EMPLOYING AN IMPROVED POROUS GLASS MEMBRANE,
National Research Development Corp., London (England).
For primary bibliographic entry see Field 3A.
W88-01786

SCALE INHIBITOR FOR REVERSE OSMOSIS WATER PURIFICATION SYSTEM,
Goodrich (B.F.) Co., Akron, OH.
For primary bibliographic entry see Field 3A.
W88-01787

REVERSE-OSMOSIS PURIFIER APPARATUS AND METHOD,
For primary bibliographic entry see Field 3A.
W88-01788

DISCHARGE OF GASES FROM SUBMARINE DESALINATION PLANTS,
Mannesmann A.G., Duesseldorf (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W88-01789

MULTI-CYLINDER REVERSE OSMOSIS APPARATUS AND METHOD,
For primary bibliographic entry see Field 3A.
W88-01790

REVERSE OSMOSIS APPARATUS AND METHOD INCORPORATING EXTERNAL FLUID EXCHANGE,
Seagold Industries Corp., Burnaby (British Columbia).
For primary bibliographic entry see Field 3A.
W88-01791

REVERSE OSMOSIS METHOD AND APPARATUS,
For primary bibliographic entry see Field 3A.
W88-01792

WATER PURIFYING AND VENDING APPARATUS,
International Mfg. and Water Vending Co., Mesa, AZ.
J. J. Hamlin.
U.S. Patent No. 4, 623,467; November 18, 1986, 17 p, 16 fig. Official Gazette of the United States Patent Office, Vol 1072, No 3, p 1146-1147, November 18, 1986.

Descriptors: *Patents, *Water treatment, *Reverse osmosis, *Domestic water, *Drinking water, *Water supply, Filtration, Process water, Disinfection, Ultraviolet radiation, Control systems.

A coin-operated vending apparatus dispenses purified water for drinking cooking, and supplying automobile batteries and radiators. An apparatus inlet is coupled to a source of water. The vending apparatus contains a reverse osmosis filter and a prefilter. The reverse osmosis filter wastewater flows to a holding sump. A purified water holding tank is coupled to the reverse osmosis water outlet and an after filter is connected to the tank outlet. The apparatus also contains ultraviolet disinfecting equipment between the after-filter outlet and the dispenser. Control systems establish a predetermined vending cycle period and the amount of purified water to be dispensed. The ultraviolet disinfecting system includes a hollow plastic housing containing a mounted lamp. An annular space between the outer surface of the lamp and the inner surface of the housing provides a flow path for the purified water. (Cremmins-AEPCO)
W88-01793

METHOD OF PRODUCING ULTRAPURE, PYROGEN-FREE WATER,
L. Boeve.
U.S. Patent No. 4,548,716; October 22, 1985, 5 p, 1 fig. Official Gazette of the United States Patent Office, Vol 1059, No 4, p 1770, October 22, 1985.

Descriptors: *Patents, *Ultrafiltration, *Water treatment, *Industrial water, *Solvents, Seawater, Drinking water, Ozonation, Reverse osmosis, Ionization, Feedwater treatment, Reclaimed water, Wastewater treatment.

Ultrapure, pyrogen-free water is produced for primary application as a pharmaceutical solvent for injection into humans or other animals and secondarily for water reclamation and clean up of toxic liquid wastes. A source of water is filtered to remove suspended solids and organics before it is deionized to remove dissolved solids. Substantially pure ozone is introduced into the deionized water at a concentration of at least 2 milligrams of ozone per liter of deionized water to produce ultrapure, pyrogen-free water. The source of water may but need not be treated by distillation, reverse osmosis, or deionization. The source can be tap water, wastewater, or seawater. If seawater is used, it is treated by reverse osmosis prior to deionization. (Cremmins-AEPCO)
W88-01794

DISTILLATION SYSTEM AND PROCESS,
Vaponics, Inc., Plymouth, MA.
For primary bibliographic entry see Field 3A.
W88-01796

METHOD OF PRETREATING RAW WATER FOR REVERSE OSMOSIS UNITS,
Steinmueller (L. und C.) G.m.b.H., Gummersbach (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W88-01797

WATER PURIFICATION PROCESS AND SYSTEM,
Allied Water Corp., San Francisco, CA.
For primary bibliographic entry see Field 3A.
W88-01798

REVERSE OSMOSIS DESALINIZATION UTILIZING PLURAL FLOW WORK EXCHANGE VESSELS,
Steinmueller (L. und C.) G.m.b.H., Gummersbach (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W88-01799

ALIPHATIC AND AROMATIC HALOCARBONS AS POTENTIAL MUTAGENS IN DRINKING WATER. III. HALOGENATED ETHANES AND ETHENES,
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
For primary bibliographic entry see Field 5C.
W88-01811

RATIONAL PROGRAM TO CONTROL UNACCOUNTED-FOR WATER,
Greeley and Hansen, Chicago, IL.
For primary bibliographic entry see Field 3D.
W88-01820

TOTAL ORGANIC HALOGEN (TOX) FORMATION POTENTIALS IN ACTIVATED SLUDGE TREATMENT AND SMALL RIVERS,
Tokyo Univ. (Japan). Dept. of Urban Engineering.
For primary bibliographic entry see Field 5D.
W88-01825

COMPARISON OF SOLVENT EXTRACTIONS AND RESIN ADSORPTION FOR ISOLATION OF MUTAGENIC COMPOUNDS FROM CHLORINATED DRINKING WATER WITH HIGH HUMUS CONTENT,
National Public Health Inst., Kuopio (Finland). Dept. of Environmental Hygiene and Toxicology.
For primary bibliographic entry see Field 5A.
W88-01837

CHLOROPICRIN FORMATION IN AQUEOUS SOLUTION: EFFECT OF NITRITES ON PRECURSORS FORMATION DURING THE OXIDATION OF ORGANIC COMPOUNDS (FORMATION DE CHLOROPICRINE EN MILIEU AQUEUX: INFLUENCE DES NITRITES SUR LA FORMATION DE PRECURSEURS PAR OXYDATION DE COMPOSES ORGANIQUES),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
H. Thibaud, J. de Laat, N. Merlet, and M. Dore.
Water Research WATRAG, Vol. 21, No. 7, p 813-821, July 1987. 4 fig, 8 tab, 13 ref.

Descriptors: *Water quality, *Drinking water, *Chemical reactions, *Nitrites, *Oxidation, *Chloropicrin, Organic compounds, Humic matter, Nitrophenols, Hydrogen ion concentration, Aromatic compounds.

The presence of trichloronitromethane (chloropicrin) in natural or drinking waters is a recent concern for hygienists and water engineers. Studies have shown that chloropicrin in public water supplies can constitute a chlorination by-product of humic substances and of nitrophenols. The presence of nitrites in reaction media might also play an important part in chloropicrin formation. The object of this study was to define the part played by nitrites during the oxidation of synthetic solutions of aromatic molecules and humic substances. The influence of pH, chlorination ratio, and nitrite concentration on chloropicrin production during the chlorination of phenolic compounds and humic substances was studied. Chemical pre-oxidation (by ozone, chlorine dioxide, monochloramine) of phenol in the presence of nitrites, and its role in the formation of chloropicrin during post-chlorination was analyzed, and several intermediate oxidation compounds were identified. (Author's abstract)
W88-01842

EFFECT OF OZONE ON PLASMID DNA OF ESCHERICHIA COLI IN SITU,
Government Industrial Development Lab., Sapporo (Japan).
K. Ishizaki, K. Sawadaishi, K. Miura, and N. Shinriki.
Water Research WATRAG, Vol. 21, No. 7, p 823-827, July 1987. 6 fig, 33 ref.

Descriptors: *Water treatment, *Wastewater treatment, *Ozonation, *Escherichia coli, Viruses, Ozone, Disinfection, DNA.

The cell suspension of Escherichia coli HB101 harboring pBR322 plasmid DNA was exposed to ozone, and the damage of plasmid DNA in vivo and also cell survival were investigated. Closed circular plasmid DNA (ccDNA) converted to open circular DNA (dcDNA) by ozone treatment. The mechanism of the conversion seemed to be similar to that observed in vitro ozone treatment of plasmid DNA. These findings indicate that ozone penetrates cell membranes and reacts with cytoplasmic substances. Therefore, chromosomal DNA may be one of targets of the ozone degradation, and its damage may be one of the factors responsible for the cell killing. (Author's abstract)
W88-01843

REACTIONS OF CHLORINE AND CHLORINE DIOXIDE WITH RESORCINOL IN AQUEOUS SOLUTION AND ADSORBED ON GRANULAR ACTIVATED CARBON,
Dames and Moore, Golden, CO.
D. E. Jackson, R. A. Larson, and V. L. Snoeyink.
Water Research WATRAG, Vol. 21, No. 7, p 849-857, July 1987. 1 fig, 4 tab, 25 ref. NSF Grant No. CEE-81-10024.

Descriptors: *Water treatment, *Chlorine, *Chlorine dioxide, *Resorcinol, *Activated carbon, Chlorination, Chemical reactions, Disinfection.

Resorcinol reacted with chlorine and chlorine dioxide at pH 7 in dilute aqueous solution and in the presence of granular activated carbon (GAC) to produce numerous chlorinated compounds. Major products included chlororesorcinols and various chlorinated cyclopentenediones. Few reaction products were found in common to both Cl2 and ClO2 when reacted with resorcinol in the absence of GAC. However, both oxidants produced the same major recoverable chlorinated product, a dichlorocyclopentenedione, when reacted with resorcinol preadsorbed on GAC columns. No products were found when aqueous resorcinol was applied to GAC columns following contact of the carbon with Cl2 or ClO2 solutions. (Author's abstract)
W88-01847

WATER SUPPLY IN MICRONESIA,
Nevada Div. of Health, Carson City.
J. Fontaine.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 7, p 64-69, July 1987. 1 fig, 1 tab, 3 ref.

Descriptors: *Water supply, *Water resources development, *Micronesia, Groundwater supply, Wells, Water quality, Public health, Water demand, Tropical regions.

Public health is severely affected by inadequate water supplies in Micronesia, a vast island-dotted area of the Western Pacific that had been held in trust by the United States from the end of World War II until recently. In Micronesia, a public water system is defined according to the Safe Drinking Water Act as serving at least 25 people for 60 or more days a year. Public water systems in Micronesia can generally be classified into those operated by public works departments, including all capital center systems, and those operated by village or community leaders. Although it is recognized that many family or individual systems could actually be classified as public water supplies, adequate information does not exist to include them in an inventory. Many residents of the island rely on catchment of rainwater for supplies; others are served by deteriorating systems carrying untreated water, i.e., springs, shallow wells, skimming wells, and deep wells. The difficulties of coping with water demand and upgrading water service in such a remote and varied tropical location are discussed. (Lantz-PTT)
W88-01889

OPERATION AND MAINTENANCE OF WATER SYSTEMS IN DEVELOPING COUNTRIES,
Agency for International Development, Washington, DC.
J. H. Austin, and J. K. Jordan.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 7, p 70-77, July 1987. 1 fig, 17 ref.

Descriptors: *Water resources development, *Water supply, *Developing countries, *Operation and maintenance, *Water conveyance, Financing, Education, Training, Construction.

As the United Nations Drinking Water and Sanitation Decade unfolds, donor organizations have found severe shortcomings in the operation and maintenance of water facilities in less developed countries, rendering service to the people less than anticipated. A review of projects by a number of donor organizations shows the following trends: (1) Many provincial town water systems that were funded and built by a donor within the last 20 years now require rehabilitation; (2) Donors put such heavy emphasis on design and construction of new facilities that host country water authority engineers resent being given an operations and maintenance (O&M) job, and therefore they constantly seek transfer to design and construction jobs; (3) Training departments that were set up when nationwide water authorities were established lose funds and personnel after a year, and both donors and the authorities do little to prevent this from happening; and (4) Donor organizations have tended to emphasize the transfer of funds to host governments for capital development and to

permit institution-building components to languish. The reasons for these difficulties (inadequate or improper maintenance) are analyzed and suggestions offered for improvement to help meet the goals of the decade. In addition to recommending greater emphasis on operational problems during the design stage, the development of management systems and trained personnel is stressed. (Lantz-PTT)
W88-01890

DEVELOPING MODELS FOR PREDICTING TRIHALOMETHANE FORMATION POTENTIAL AND KINETICS,
Arizona Univ., Tucson. Dept. of Civil Engineering.
G. L. Amy, P. A. Chadik, and Z. K. Chowdhury.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 7, p 89-97, July 1987.

Descriptors: *Water treatment, *Trihalomethanes, *Water pollution sources, *Model studies, *Chlorination, Computer models, Chemical reactions, Reaction kinetics, Sensitivity analysis, Statistical analysis, Disinfection, Water quality control.

The development, including formulation and calibration, of linear and nonlinear multiple regression models for predicting total trihalomethane formation potential and kinetics during the chlorination of natural waters is described. The rationale behind each model formulation is discussed, and statistics relating to the calibration of each model are presented. The testing and attempted validation of these models are also addressed. Each model is subjected to a sensitivity analysis and a validation analysis using data derived from the literature. (Author's abstract)
W88-01893

REMOVING TRIHALOMETHANE PRECURSORS BY COAGULATION,
Pirnie (Malcolm), Inc., Newport News, VA.
R. E. Hubel, and J. K. Edzwald.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 7, p 98-106, July 1987. 7 fig, 8 tab, 26 ref. Allied Chemical Co. Grant No. 328233 and EPA Contract No. CR807034.

Descriptors: *Trihalomethanes, *Coagulation, *Water treatment, Humic matter, Jar tests, Alum, Polymers, Turbidity, Water quality.

The removal of trihalomethane precursors by coagulation was studied with low turbidity, low alkalinity waters containing high levels of aquatic humic matter. Jar tests were conducted with synthetic and natural waters using alum, high-molecular-weight polymers, cationic polymers, and various combinations of these coagulants. Cationic polymers alone were found to be less effective than alum in the coagulation of humic substances. High-molecular-weight polymers used as coagulant aids with alum, improved turbidity removal but not precursor removal, whereas high-charge-density cationic polymers with alum as a coagulant aid provided good precursor removals at low alum dosages. (Author's abstract)
W88-01894

REMOVAL OF TASTE-AND ODOR-CAUSING COMPOUNDS BY BIOFILMS GROWN ON HUMIC SUBSTANCES,
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
E. Namkung, and B. E. Rittman.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 7, p 107-112, July 1987. 2 fig, 4 tab, 68 ref. EPA Contract No. CR810462.

Descriptors: *Taste, *Odor, *Water treatment, *Biofilms, *Humic matter, *Water quality control, Biodegradation, Fulvic acid, Peat, Drinking water, Water quality, Activated carbon, Filtration.

Laboratory experiments showed that biodegradation of taste- and odor-causing compounds by biofilms grown on natural humic materials is feasible. Although the mineralization of peat fulvic acid (PRF) was relatively low (about 10%), long-term application of the PFA resulted in a significant amount of biofilm mass in the reactor and allowed the secondary utilization of trace levels of taste and odor compounds. These results suggest that biofilms grown on natural organic materials can play an important role in removing taste and odor compounds during water treatment. Examples of drinking water treatment processes that allow good biofilm accumulation are granular activated carbon, sand filters, river bank filtration, submerged fixed-bed reactors, and fluidized-bed reactors. (Author's abstract)
W88-01895

DEAD ENDS, RED WATER, AND SCRAP PILES,
J. R. Rossum.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 7, p 113-115, July 1987. 1 fig, 1 tab, 4 ref.

Descriptors: *Red water, *Water pollution sources, *Scrap piles, Langelier index, Calcium carbonate, Alkalinity, Corrosion, Oxygen, Iron, Steel.

The fact that iron corrosion products can form protective films has been thoroughly discussed. Previous observations cast doubt on the infallibility of a negative Langelier index as an indication of the occurrence of red water but the fact that rusty water bleeding from dead ends can be a significant source of complaints about red water is not widely recognized. It is suggested that high values of buffer capacity do not inhibit corrosion. The highest alkalinity has the highest buffer capacity, but it is the most corrosive. Except for the calcite found on bronze surfaces, the scrap piles showed no evidence of a thin, coherent, protective scale of calcium carbonate - even for those systems in which a positive Langelier index had been maintained. The benefit of having a calcium carbonate precipitation potential greater than 1 appears to lie in the ability of calcium carbonate to strengthen and harden iron corrosion products so that they remain on the pipe wall and do not cause red water. Observations made on scrap piles of several water systems have shown the following: (1) Oxygen concentration cells are formed in dead ends where iron corrosion occurs; (2) No corrosion occurs in the complete absence of oxygen in the water. In the presence of oxygen, corrosion rates are not proportional to the oxygen concentration; (3) A film consisting of calcium carbonate is found on the bronze parts of valves. This is not surprising because copper alloys are several hundred millivolts cathodic to iron; (4) Iron and steel surfaces were coated with iron carbonate, magnetite, and ferric oxide. No calcium carbonate films were found; (5) Magnetite or ferrous ferrite is formed by the reaction between ferrous ions and various species of ferrite ions; (6) Complaints about red water are minimal in many waters with a Langelier index near zero; and (7) Complaints about red water are frequent when less than one molecule of calcium carbonate is formed for each molecule of hydroxide added, even when the Langelier index is positive. (Lantz-PTT)
W88-01896

EFFECTS OF SEVERAL IONS ON IRON TREATMENT BY SODIUM SILICATE AND HYPOCHLORITE,
Tennessee Univ., Knoxville. Dept. of Civil Engineering.
R. B. Robinson, R. A. Minear, and J. M. Holden.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 7, p 116-125, July 1987. 6 fig, 7 tab, 21 ref.

Descriptors: *Water treatment, *Water quality control, *Iron, *Sodium silicate, *Hypochlorite, Corrosion, Chemical reactions.

Several ions were studied for their effect on an innovative iron treatment process under controlled laboratory conditions. The iron treatment method stabilizes iron by adding sodium silicate and chlorine. Calcium greatly increased the silicate dosage necessary to maintain low turbidity and high iron filterability. Iron was stabilized for more than 10 days at a 12 mg/L silicate dosage as SiO_2 without calcium, but precipitated after 3 days in the presence of 10 mg calcium as $CaCO_3$/L. With 100 mg Ca/L, iron precipitated before one day. Sodium had approximately 100 times less effect than calcium. Equilibrium calculations and analysis of previous work show that calcium's action is not a simple complexation with silicate. Rather, the effect of calcium is hypothesized to be a divalent cation acting on a negatively charged colloid. (Author's abstract)
W88-01897

CONSIDERATIONS INVOLVED IN THE REACTIVATION OF AN EXISTING WATER SUPPLY,
Massachusetts Water Resources Authority, Boston. Waterworks Div.
W. A. Brutsch, and S. L. Bishop.
Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 41, No. 3, p 206-218, June 1987. 10 fig, 1 tab.

Descriptors: *Water treatment, *Drinking water, *Water quality control, *Sudbury, *Massachusetts, Water quality, Costs, Economic aspects, Water supply.

The Metropolitan District Commission's Water System serves approximately 2.5 million people in 45 communities from Chicopee, Massachusetts to Boston, Massachusetts. These communities have an average daily demand in excess of 300 million gal/d. Thirty-five communities in the Greater Boston area make up what is known as the Metropolitan Water District. Twenty-five of these communities are fully supplied members and ten communities are partially supplied members. There are also ten communities which are provided with water under contract. Quabbin and Wachusett Reservoirs, which serve the Metropolitan Water System, have a combined capacity of 477 billion gallons of water. These two reservoirs receive water from a 392 sq mi drainage area which consists of three watersheds: Quabbin, Ware River, and Wachusett. A fourth watershed, the Sudbury River watershed, consisting of 75.2 sq mi, is located in the Southborough/Framingham area. The Metropolitan District Commission does not include the Sudbury River watershed in its calculation of system safe yield at this time because it cannot function as an ongoing source without additional water treatment. The safe yield of existing Metropolitan District Commission supply sources is approximately 300 million gal/d excluding Sudbury River watershed. Described are the technical considerations which were evaluated to identify an economical and effective method of treating the Sudbury supply. Once these technical elements have been defined and a final selection of a treatment process has been made, the associated operating conditions and costs become a part of the decision making process as to whether to reactivate the supply. The results of extensive pilot plant testing of the hydraulic pulsed upflow clarification-filtration and ozonation-filtration systems indicated that both will produce filtered water that satisfied State requirements. In general, hydraulic pulsed upflow clarification-filtration system was affected less by changes in color, turbidity, and algae than the ozonation-filtration system. Estimates of construction and operating costs between the two systems indicated that the hydraulic pulsed upflow clarification-filtration system exhibited life cycle costs of 76% of the ozonation-filtration system. (Lantz-PTT)
W88-01898

TOXICOLOGY OF ORGANIC MICROPOLLUTANTS IN DRINKING WATER: ESTIMATING THE RISK,
Water Research Centre, Medmenham (England).
For primary bibliographic entry see Field 5G.
W88-01899

DISINFECTION OF ANION EXCHANGE RESINS IN THE COMBINED ION EXCHANGE/BIOLOGICAL DENITRIFICATION

PROCESS, PART I: EFFECT ON WATER QUALITY,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
J. P. Hoek, J. Verheijen, P. I. M. Vis, and A. Klapwijk.
Zeitschrift fur Wasser-und Abwasser-Forschung ZWABAQ, Vol. 20, No. 5, p 155-160, October 1987. 1 fig, 9 tab, 30 ref.

Descriptors: *Disinfection, *Anion exchange, *Resins, *Water treatment, *Denitrification, Ion exchange, Bacteria, Peracetic acid, Groundwater quality, Hydrogen peroxide.

Contamination of groundwater with nitrate is an important problem in several European countries. The combined ion exchange/biological denitrification process is a technique for nitrate removal from groundwater. In this process the resins are regenerated with a biological denitrification reactor. However, this causes a bacterial contamination of the resins and the colony counts in the treated water will be increased by the resins. For that reason the resins have to be disinfected after regeneration during the rinse phase, before they are used for nitrate removal again. Two disinfectants can be used. Peracetic acid is suitable in a concentration of 0.075% and a contact time of 15 min. In the combined ion exchange/biological denitrification process this results in a peracetic acid use of 1.875 g/L resin each regeneration, or 1.0 g/L resin when the disinfectant is recirculated the last 7 min. Hydrogen peroxide is suitable in a concentration of 0.20% with a contact time of 45 min, resulting in a hydrogen peroxide use of 15.0 g/L resin each regeneration. The latter is probably influenced by the presence of silver in the concentrated hydrogen peroxide solution. With the use of these disinfectants the treated groundwater contains < 30 cells/ml, and fulfills the EC standard of a maximum acceptable colony count of 100/ml. (Lantz-PTT)
W88-01973

ROLE FOR WATER SUPPLY AND SANITATION IN THE CHILD SURVIVAL REVOLUTION,
North Carolina Univ. at Chapel Hill. School of Public Health.
J. Briscoe.
PAHO Bulletin, Vol. 21, No. 2, p 93-105, 1987. 4 fig, 7 tab, 29 ref.

Descriptors: *Public health, *Water supply, *Water quality control, *Sanitation, Cost-benefit analysis, Public policy, Public investment.

Improvements in water supply and sanitation conditions played a fundamental role in improving health in industrialized countries during the nineteenth century. In the mid-1970s it was generally agreed that water supply and sanitation had a similar role to play in the transition to low mortality rates in developing countries. As a consequence, water supply and sanitation were included as integral parts of the primary health care (PHC) package, and the 1980s were declared to be the United Nations' International Drinking Water Supply and Sanitation Decade. Upon closer examination of the PHC strategy, it was argued that insufficient resources were available to implement the complete package of PHC interventions, and that only those interventions which were most cost-effective in terms of reducing infant mortality should be implemented. In particular, it was argued that the cost per infant death averted through water supply and sanitation programs was much higher than the cost per infant death averted through a selective primary health care package that included oral rehydration therapy, DPT and measles immunizations, malaria treatment, and breast-feeding. The current strategy for the 'Child Survival Revolution' gives low priority to improvements in water supply and sanitation. This conclusion is incorrect for the following reasons: (1) Because water supply and sanitation projects have multiple impacts, care needs to be exercised in applying conventional cost-effectiveness techniques to such projects; (2) Because adequate water supply and sanitation facilities are necessary but not sufficient conditions for improvements in health, the provision of improved facilities may be essential for improving health even though this does not have a large, immediate impact on health status; (3) The long-term effect on child survival resulting from improved water supply and sanitation conditions is probably substantially greater than would be expected on the basis of an assessment of the immediate effects on diarrheal disease; and (4) a review of the immediate impact of water supply and sanitation projects on morbidity due to diarrheal diseases shows that these impacts are usually substantial. (Lantz-PTT)
W88-01990

MUTAGENICITY STUDIES IN SALMONELLA: RESIDUES OF OZONATED AND/OR CHLORINATED WATER FULVIC ACIDS,
Environmental Health Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W88-02058

APPLYING LESSONS FROM HOUSING TO MEETING THE CHALLENGE OF WATER AND SANITATION FOR THE URBAN POOR,
California Univ., Berkeley. Inst. of Urban and Regional Development.
T. Campbell.
American Planning Association Journal JAPAD9, Vol. 53, No. 2, p 186-192, Spring 1987. 1 fig, 15 ref.

Descriptors: *Economic aspects, *Water quality, *Water supply, *Sanitation, *Housing, *Public health, Latin America, Costs, Diseases, Wastewater treatment.

The pace of investments in water and sanitation lags far behind urban population growth in Latin America and the Caribbean. The health consequences of this shortfall amount to hundreds of thousands of deaths annually. This article suggests that a sociotechnical strategy is required, based on the housing experience of the past few decades, to reduce costs of producing sanitation and to minimize the risk of disease. The strategy involves fundamentally altered assumptions about state responsibility for water and sanitation. Concomitantly, beneficiaries must do more to build, operate, and maintain water and wastewater systems. (Author's abstract)
W88-02062

WATER RE-USE SYSTEM FOR PRODUCTION OF FINGERLING FISHES IN BRAZIL WITH EMPHASIS ON SOUTH AMERICAN CATFISHES (RHAMDIA QUELENS AND R. SAPO),
Universidade Federal de Santa Maria (Brazil). Dept. Zootechnica.
J. R. Neto, C. C. Kohler, and W. M. Lewis.
Tropical Agriculture TAGLA2, Vol. 64, No. 1, p 2-6, January 1987. 2 fig, 3 tab, 18 ref.

Descriptors: *Wastewater treatment, *Fisheries, *Water reuse, *Brazil, *Juvenile growth stage, *Catfish farming, *Recirculated water, *Biofiltration, Growth stages, Fish, Fish farming, Filtration, Water quality, Eggs, Fish eggs, Incubation, Tilapia, Carp, Aquaculture, Reservoirs, Pipes, Valves, Fish diseases, Animal diseases.

An indoor tank facility supplied with water and incorporating Biofiltration was constructed in 1981 at the Fishculture Station of the Federal University of Santa Maria, Brazil. The system has proven extremely effective in maintaining water quality for the production of fingerling fishes. South American catfishes (Rhamdia quelens) have been reared successfully for 12 months from egg incubation within the system. Other species which have been maintained in the system 1-3 months include R. sapo, common and mirror carp (Cyprinus carpio), and tilapias (Tilapia nilotica and T. rendalli). In addition to a description of the water reuse system, the basic biological and chemical mechanisms that underlie it use are reviewed. (Author's abstract)
W88-02080

CHARACTERIZATION OF ADSORBATES FROM ACTIVATED CARBON COLUMNS PART I: THE EFFECT OF RAW WATER PRETREATMENT ON THE SORPTION OF ORGANOHALOGEN COMPOUNDS,
National Inst. for Water Research, Pretoria (South Africa).
R. A. van Steenderen, L. Weil, and B. M. van Vliet.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 20, No. 2, p 49-53, April 1987. 3 fig, 5 tab, 15 ref.

Descriptors: *Activated carbon, *Chlorinated hydrocarbons, *Ozonation, *Pretreatment of water, *Water treatment, *Adsorption, Wastewater treatment, Economic aspects, Chlorination.

Pilot plant studies to determine the effect of different preoxidants on the lifespan of granular activated carbon (GAC) in water reclamation are described. Low ozonation dosages (< 3 mg/l) followed by filtration not only enhanced the lifespan of GAC but also increased the ratio of volatile to non-volatile adsorbates which is favorable for carbon regeneration purposes. GAC treatment is expensive (it can constitute up to 80% of the costs of operating a water purification plant). Any technique (such as described here) which can lengthen GAC life expectancy with respect to predetermined quality criteria is of great value. Further studies now underway will investigate whether the molecular mass distribution profile can assist in selecting an appropriate GAC for optimal removal of a specific compound, e.g. organochlorine compounds. (Airone-PTT)
W88-02085

SOME EXPERIENCE IN SOFTENING THE OILFIELD WATERS BY ION EXCHANGE FOR STEAMFLOOD OPERATION,
Koomey, Inc., Brookshire, TX. Engineering Dept.
For primary bibliographic entry see Field 5D.
W88-02156

SYSTEMATIC APPROACH TO THE DETECTION AND REMOVAL OF TOXIC ORGANIC POLLUTANTS IN DRINKING WATER,
State Univ. of New York at Albany. Dept. of Chemistry.
A. M. Bryan.
Available from the National Technical Institute Service Springfield, VA 22161. Final Technical Completion Report, 66 p, 23 fig, 6 tab, 19 ref, append. Department of the Interior Contract No. 14-34-001-1249, Project No. B-093-NY(1).

Descriptors: *Water treatment, *Pollutant identification, *Water quality control, *Drinking water, *Organic compounds, Water treatment, Toxicity, Ames test, Microbiological studies, Chemical analysis, Liquid chromatography, Solvent extraction, Mutagens, Carcinogens, Salmonella, Soil analysis, Tissue analysis, Water analysis.

Biological and chemical tests on unfractionated environmental samples - such as ambient air, drinking water and effluents from industrial plants - may fail to detect those genotoxic (causing gene defects) components that require removal or neutralization to assure protection of target organisms (especially man). If for whatever reasons, these genotoxic materials go undetected, the very purpose of environmental testing is sabotaged. To overcome the deficiencies of whole sample testing, the linking of conventional biological and chemical procedures must be used. Chemical fractionation of the whole sample produces specific subfractions that can be analyzed further to identify the active components. Bioassays of these subfractions can characterize the biological effect(s). Both chemical and biological techniques can then be used to quantitate the amount of toxicant present, and the extent of the biological damage. Test methods for environmental sampling, such as the Ames microbiological mutagenesis test, solvent extraction and liquid chromatography are discussed as methods for revealing the mutagenic/carcinogenic properties of its components. A general preparative procedure has been developed for the isolation of mutagenic components from organic residues in soil and water samples. This procedure features the

Salmonella-microsome mutagenicity assay coupled with an analytical fractionation method which progressively focuses on the bioactive constituents of the complex mixture. The three-step method consists of: semi-solid/liquid extraction; fractionation via HPLC; and SEP-Pak concentration and solvent elution of fractions for further separation via HPLC to provide subfractions for chemical and biological characterization. Indirect sampling of pollutants by selected bioextractors provides a critical adjunct to direct sediment or water analysis. The research carried out here was designed to provide a coupled bioassay/chemical fractionation method for use in detecting organic residues in soil, tissues and water samples. (Lantz-PTT)
W88-02274

WATER CONSERVATION AND MANAGEMENT IN BARROW, ALASKA,
Northern Testing Lab., Inc., Fairbanks, AK.
For primary bibliographic entry see Field 3D.
W88-02312

USING ASIATIC CLAMS AS A BIOMONITOR FOR CHRYSOTILE ASBESTOS IN PUBLIC WATER SUPPLIES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
For primary bibliographic entry see Field 5A.
W88-02318

USING ALTERNATIVE OXIDANTS TO REMOVE DISSOLVED MANGANESE FROM WATERS LADEN WITH ORGANICS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. R. Knocke, R. C. Hoehn, and R. L. Sinsabaugh.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 3, p 75-79, March 1987. 11 fig, 2 tab, 7 ref.

Descriptors: *Manganese, *Organic compounds, *Water treatment, *Oxidation, *Chlorine, *Potassium compounds, Performance evaluation, Heavy metals, Hydrocarbons, Chlorinated hydrocarbons, Carbon, Organic carbon, Temperature, Hydrogen ion concentration, Acidity, Chemical properties, Physical properties.

The potential use of four oxidants is reviewed for manganese removal. The effects of changes in total organic carbon concentration of the raw water, temperature, and pH on oxidation efficiency were evaluated using three different water sources in Virginia. Conventional water treatment practices were simulated in the laboratory through the use of a standard 6-place jar-test apparatus. Three of the oxidants (chlorine, potassium permanganate, and chlorine dioxide) were found to be effective for Mn oxidation. Hydrogen peroxide was ineffective. Free chlorine was effective only under alkaline pH conditions, and its use would be limited to waters with low trihalomethane formation potentials. Other oxidants were quite costly, oxidized Mn inefficiently in the presence of significant organic matter, or were not highly effective at low temperatures. It is concluded that each treatment facility should test oxidants on-site to determine which promote Mn oxidation under the range of conditions at that facility. (Author's abstract)
W88-02319

IMPORTANCE OF WHITING AS A COMPONENT OF RAW WATER TURBIDITY,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 3, p 80-82, March 1987. 6 fig, 21 ref.

Descriptors: *Carbonates, *Turbidity, *Water quality management, *Hardness, *Lakes, *Reservoirs, Physical properties, Chemical properties, Chemical reactions, Chemistry, Distribution, Temporal distribution, Vertical distribution.

Carbonate precipitate (whiting) represents a significant, sometimes dominant, component of turbidity in many hard-water lakes and reservoirs. The chemistry, driving forces for occurrence, ubiquity, and important features of whiting are reviewed. Turbidity associated with whitings was determined for several hard-water central New York State lakes, using the difference between the turbidity of an unacidified sample and that following acidification (pH = 4.0). The temporal distributions of overall turbidity and of the whiting component of turbidity are presented. The vertical distribution of whiting was found to be sensitive to thermal stratification. Manifestations of whiting can easily be mistaken for a phytoplankton bloom. It is concluded that the whiting component of turbidity should be monitored routinely in hard-water lakes to provide insight into water quality management and treatment plant operations. A preliminary two-year program is recommended to establish the importance of whiting to raw water turbidity. The simple technique of sample acidification is suggested for determining turbidity caused by whiting. (Author's abstract)
W88-02320

TESTING OF ALUM RECOVERY FOR SOLIDS REDUCTION AND REUSE,
Environmental Engineering and Technology, Inc., Newport News, VA.
M. M. Bishop, A. T. Rolan, T. L. Bailey, and D. A. Cornwell.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 6, p 76-83, June 1987. 6 fig, 14 tab, 2 ref.

Descriptors: *Water treatment, *Alum recovery, *Sludge, Sludge disposal, Coagulation, Phosphorus removal, Wastewater treatment, Wastewater, Alum.

Alum recovery has recently gained more attention because many water utilities need to improve their sludge handling and disposal practices. As part of an overall sludge management program, alum recovery can reduce the amount of solids and allow for reuse of the recovered alum as a coagulant. It also has other potential uses such as phosphorus control at wastewater treatment plants. (Author's abstract)
W88-02395

TECHNOLOGY OF SMALL COMMUNITY WATER SUPPLY SYSTEMS IN DEVELOPING COUNTRIES,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
S. V. R. Rao, and J. A. Rasmussen.
Journal of Water Resources Planning and Management JWRMD5, Vol. 113, No. 4, p 485-497, July 1987. 3 tab, 31 ref.

Descriptors: *Drinking water, *Potable water, *Water supply, *Developing countries, *Water resources development, Groundwater, Rainfall, Surface water, Technology.

The professed goal of the World Health Organization - to supply potable water to the poorest of the poor in the developing countries by the year 1990 - appears to be quite an optimistic one in view of the existing situation in the developing countries, where potable water is still out of the reach of 80% of the populace. Supplying potable water to the rural population in these countries is quite a gigantic task owing to lack of physical and institutional resources. Any major effort at providing safe potable water to rural populations should first aim at improvement of the small community water supply systems. Small community water supply systems in these countries generally include: (1) Groundwater supplies; (2) rain water storage basins; and (3) surface water storage basins. Existing technologies of small community water supply systems in Indonesia and India are discussed and recommendations are made for improving their technical performance to meet the professed United Nations potable water supply goals. (Author's abstract)
W88-02414

OPTIMAL AQUEDUCT CAPACITY AND DISTRIBUTION POLICY: CONTINUOUS APPROACH,
California Univ., Davis. Dept. of Land, Air and Water Resources.
L. E. Flynn, and M. A. Marino.
Journal of Water Resources Planning and Management JWRMD5, Vol. 113, No. 4, p 533-549, July 1987. 2 fig, 2 tab, 20 ref. ARS Cooperative Agreement 4350-H.

Descriptors: *Optimization, *Design standards, *Water conveyance, *Model studies, *Water distribution, *Economic aspects, Water supply, Water use, Distribution.

Methods for determining the optimal design capacities and distribution management of water delivery systems in the presence of probabilistic supplies and known transportation losses are presented. A continuous distance model of the conveyance system, solved by calculus of variations, is used to expose and explain a variety of economic tradeoffs, capacity design patterns, and water distribution patterns that occur in economically optimal delivery systems. The results rely on optimality conditions developed. Supply variability and users' supply levels are shown to have important influences on the optimal solutions. (See also W88-02419) (Author's abstract)
W88-02418

OPTIMAL AQUEDUCT CAPACITY AND DISTRIBUTION POLICY: DISCRETE APPROACH,
California Univ., Davis. Dept. of Water Science and Engineering.
M. A. Marino, and L. E. Flynn.
Journal of Water Resources Planning and Management JWRMD5, Vol. 113, No. 4, p 550-562, July 1987. 2 fig, 13 ref. ARS Cooperative Agreement 4350-H.

Descriptors: *Agriculture, *Optimization, *Design standards, *Water conveyance, *Water distribution, *Model studies, *Economic aspects, Water supply, Water use, Distribution, Urban areas.

Methods for determining the optimal design capacities and distribution management of water delivery systems in the presence of probabilistic supplies and known transportation losses are developed. A discrete distance model of the conveyance system is solved by using dynamic programming. In the method's development, important general general economic interactions are detailed. The practical value of the model is demonstrated in an example for an aqueduct to serve four farming areas and one urban area. In the example, the method finds the optimal capacities and distribution patterns for the aqueducts, and the net expected benefits for the users for four management options being considered by the urban area. This provides the urban area with the information needed to compare the options. (See also W88-02418) (Author's abstract)
W88-02419

RELIABILITY INDICES FOR WATER SUPPLY SYSTEMS,
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
R. M. Vogel.
Journal of Water Resources Planning and Management JWRMD5, Vol. 113, No. 4, p 563-579, July 1987. 4 fig, 3 tab, 38 ref.

Descriptors: *Flood control, *Design standards, *Return flow, *Model studies, *Reservoirs, Water supply, Hydroelectric power.

In the design of hydraulic structures for flood control, it has become standard practice is employ the average return period of a flood as the design event. This study introduces an analogous index for the design of a water supply system: the average return period of a reservoir system failure, defined as the expected number of years until the first reservoir system failure. Here a failure is defined as a year in which the prespecified yield could not be delivered by a water supply system. The mean and variance of the time until the first

reservoir system failure are derived, as are the mean and variance of the duration of a reservoir system failure for a simple Markov failure model. Other indices of the reliability of a water supply system are also introduced. The assumption that sequences of reservoir surplus and failures can be represented by a two-state Markov chain is validated for the Pacific Northwest Hydroelectric Power System. (Author's abstract)
W88-02420

RATIONAL BASES FOR DESIGNING VAPOUR COMPRESSION WATER DESALINATION SYSTEMS,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 3A.
W88-02428

PRETREATMENT OF SEAWATER BY FLOCCULATION AND SETTLING FOR PARTICULATES REMOVAL,
Hebrew Univ. Jerusalem (Israel). Graduate School of Applie Science and Technology.
For primary bibliographic entry see Field 3A.
W88-02429

COMBINED RO/VC DESALINATION SYSTEM,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 3A.
W88-02430

EFFICIENT ENERGY UTILIZATION IN SINGLE PURPOSE DESALINATION PLANTS,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 3A.
W88-02431

TREATMENT OF DISTILLATES AND PERMEATES FROM SEAWATER DESALINATION PLANTS,
Fichtner, Beratende Ingenieure fuer Energie- und Waermewirtschaft G.m.b.H. und Co. K.G., Stuttgart (Germany, F.R.)
For primary bibliographic entry see Field 3A.
W88-02432

COMPUTER ANALYSIS JUSTIFIES DESALINATION,
University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Programme.
For primary bibliographic entry see Field 3A.
W88-02433

EFFECT OF CELL THICKNESS AND FLOW VELOCITY ON WATER COST IN DESALINATION BY ELECTRODIALYSIS,
GKSS - Forschungszentrum Geesthacht G.m.b.H., Hamburg (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W88-02435

CURRENT AND LONG TERM CONSIDERATIONS FOR THE APPLICATION OF REVERSE OSMOSIS TECHNOLOGY IN ISRAEL,
Mekoroth Water Co., Tel-Aviv (Israel).
For primary bibliographic entry see Field 3A.
W88-02436

DESALINATION OF HIGH SALINITY BRACKISH WATER -- LOW PRESSURE REVERSE OSMOSIS,
Mekoroth Water Co., Tel-Aviv (Israel).
For primary bibliographic entry see Field 3A.
W88-02437

PRECIPITATION EQUILIBRIUM DURING EVAPORATION OF WATER CONTAINING HIGH DISSOLVED SALTS,
Calgon Corp., Pittsburgh, PA.
For primary bibliographic entry see Field 3A.
W88-02443

ANALYSIS OF LAMINAR FLOW PRECIPITATION FOULING ON REVERSE OSMOSIS MEMBRANES,
Technion - Israel Inst. of Tech., Haifa. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 3A.
W88-02444

DEMONSTRATION PLANT FOR SEAWATER DESALINATION BY REVERSE OSMOSIS (RO-2 HOLLOW FIBRE MODULE LINE),
Hager und Elsaesser G.m.b.H., Stuttgart (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W88-02445

PROBLEM OF 'RED WATERS': A NEW APPROACH TO ITS SOLUTION,
Water and Electricity Dept., Abu Dhabi (United Arab Emirates).
For primary bibliographic entry see Field 2K.
W88-02447

REJECTION SPECTRA OF REVERSE OSMOSIS MEMBRANES DEGRADED BY HYDROLYSIS OR CHLORINE ATTACK,
Louisville Univ., KY. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 3A.
W88-02448

CALCULATION OF STREAM CONCENTRATIONS IN REVERSE OSMOSIS PROCESSES,
Yugoslav Academy of Sciences and Arts, Dubrovnik. Inst. for the Protection of Materials from the Influence of Sea Water and Desalination.
For primary bibliographic entry see Field 3A.
W88-02449

TESTING RO DESALINATION AT VERY HIGH RECOVERIES IN THE ARABIAN GULF (GKSS PLATE SYSTEM),
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)
For primary bibliographic entry see Field 3A.
W88-02450

MALTA SEAWATER RO FACILITY,
Polymetrics, Inc., Sunnyvale, CA.
For primary bibliographic entry see Field 3A.
W88-02451

MALTA SEAWATER RO FACILITY - UPDATE ON THE FIRST TWO YEARS OPERATION,
Polymetrics, Inc., Sunnyvale, CA.
For primary bibliographic entry see Field 3A.
W88-02452

SUPPLY OF DESALTED WATER TO REMOTE ARID ZONES,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Nuclear Engineering.
For primary bibliographic entry see Field 3A.
W88-02453

SELECTION OF SOLAR DESALINATION SYSTEM FOR SUPPLY OF WATER IN REMOTE ARID ZONES,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Nuclear Engineering.
For primary bibliographic entry see Field 3A.
W88-02454

COMPARISON OF VARIOUS DESIGNS OF SOLAR STILLS,
Indian Inst. of Tech., New Delhi. Centre of Energy Studies.
For primary bibliographic entry see Field 3A.
W88-02455

FORMULAS FOR CALCULATING THE APPROACH TO EQUILIBRIUM IN OPEN CHANNEL FLASH EVAPORATORS FOR SALINE WATER,
Pennsylvania Univ., Philadelphia. Dept. of Mechanical Engineering and Applied Mechanics.
For primary bibliographic entry see Field 3A.
W88-02456

MULTI-EFFECT BOILING DESALTING SYSTEM AND ITS COMPARISON WITH THE MULTI-STAGE FLASH SYSTEM,
Kuwait Univ., Safat. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 3A.
W88-02457

INCIDENCE OF ANTIBIOTIC RESISTANT BACTERIA IN DRINKING WATER IN CAIRO,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
For primary bibliographic entry see Field 5B.
W88-02486

5G. Water Quality Control

MUNICIPAL WASTEWATER TREATMENT PLANT SLUDGE,
Michigan Dept. of Natural Resources, Lansing.
For primary bibliographic entry see Field 5E.
W88-01501

DISCUSSION OF GROUNDWATER MONITORING,
Environmental Data, Inc., Grand Rapids, MI.
For primary bibliographic entry see Field 7A.
W88-01518

FEDERAL REGULATORY CONSIDERATIONS IN SLUDGE UTILIZATION,
Environmental Protection Agency, Chicago, IL. Water Div.
G. A. Vanderlaan.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 273-280, 3 tab, 7 ref.

Descriptors: *Federal jurisdiction, *Sludge disposal, *Regulations, Waste management, Rural areas, Wastewater treatment, Municipal wastewater.

Sludge management is directly related to such other societal growth problems as the availability of land and diminishing supplies of materials and energy. Since 1970 the fastest population growth has been in rural areas, not in the cities. People are moving out of the largest cities in substantial numbers into counties with the lowest population densities. Rural planning capabilities and land use controls, where they exist, cannot anticipate or regulate the rapid pace of new development. Further, rural fiscal resources often cannot meet the demands for such public services as sewers, schools, medical facilities, police and fire protection, which are created by new residents. The many tasks confronting municipalities experiencing population increases include planning sewage treatment improvements - expansions or entirely new systems. One of the first tasks in the planning stage should be the development of a sludge management program. The end product of the wastewater treatment operation should be dealt with at the very beginning of the planning process. Municipal sludge treatment and handling should be an issue of public decision-making and should be brought out of the conference rooms of sanitary engineers and contractors who have been trained in designing and building bigger and better treatment systems. In these communities there have to be citizens trading ideas about what kind of future sludge management programs are best for their area. (See also W88-01499) (Lantz-PTT)
W88-01521

THIRD UNITED STATES - THE NETHERLANDS MEETING ON DREDGING AND RELATED TECHNOLOGY.
Available from the National Technical Information Service, Springfield, VA 22161. 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. 305 p.

Descriptors: *Navigation, *Waste disposal, *Water pollution control, *Dredging, *Conferences, Symposium, Sedimentation, Channels.

The Third United States - The Netherlands meeting on dredging and related technology was held 10-14 September 1984 in Charleston, South Carolina. The meeting is held under a Memorandum of Understanding between the US Army Corps of Engineers and The Netherlands Ministry of Transport and Public Works. The meeting offers a forum for exchange of information concerning problems of mutual concern between technical specialists of the signatory nations. As was done previously, the third meeting was held in the form of 1-1/2 days of plenary sessions of general interest and 1-1/2 days of technical workshop sessions. The technical subjects for the three work groups were: (a) Dredged material disposal strategies; (b) Management of contaminated dredged material; and (c) Navigation channels. The workshops examined problems of concern and proposed recommended future courses of action in attempting to solve some of the questions. This report presents the technical workshop sessions and their summaries and findings. (See W88-01523 thru W88-01553) (Author's abstract)
W88-01522

CAPPING CONTAMINATED DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5E.
W88-01535

PREDICTION AND FIELD EVALUATION OF THE WATER QUALITY OF EFFLUENT FROM CONFINED DISPOSAL AREAS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W88-01537

DREDGING AS A CLEANUP METHOD FOR AN INDUSTRIALIZED BAY,
Army Engineer District, Seattle, WA. Seattle District.
K. Phillips.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 142-148, 5 tab.

Descriptors: *Cleanup operations, *Bays, *Dredging, *Commencement Bay, *Washington, *Water pollution control, Costs, Waste disposal, Site selection.

The Commencement Bay Superfund site is unique among national priority sites in that (a) the site covers a large geographic area, including a river, seven navigation waterways, more than 10 miles of shoreline, and major portions of the City of Tacoma, Washington; (b) much of the site contamination has been found in the marine environment of the bay; and (c) remedial action for the site is expected to include dredging and disposal of contaminated sediments. A major output of the remedial investigations of the site, scheduled for completion in December 1984, will be the identification of 'problem' sediments that are sufficiently hazardous in place to warrant Superfund remedial action. By agreement with the State of Washington, Department of Ecology, the Seattle District, US Army Corps of Engineers, conducted an evaluation of alternative dredging methods and equipment, disposal methods and sites, and site control and treatment practices for contaminated sediments from the bay nearshore area. The alternatives analysis was based on three evaluation factors: (a) cost of each alternative, (b) degree of contaminant confinement and release resulting with each alternative, and (c) considerations and limitations specific to each alternative. Characteristics of the dredges evaluated, and alternative disposal methods, site control practices, and treatment options considered, along with their respective costs, are summarized in tabular form. (See also W88-01522) (Lantz-PTT)
W88-01539

DEVELOPMENT OF CRITERIA FOR THE DREDGING AND DISPOSAL OF CONTAMINATED DREDGED MATERIAL,
Rotterdam Public Works Dept. (Netherlands).
For primary bibliographic entry see Field 5E.
W88-01540

DREDGING OF POLLUTED SEDIMENT IN THE FIRST PETROLEUM HARBOR, ROTTERDAM,
Volker (Adriaan) Dredging Co., Rotterdam (Netherlands).
For primary bibliographic entry see Field 5E.
W88-01542

IMPROVED TECHNIQUES FOR REMOVAL OF SEDIMENTS CONTAMINATED WITH HAZARDOUS MATERIALS,
JRB Associates, Inc., McLean, VA.
R. S. Wetzel, A. N. Tafuri, and J. R. Sinclair.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 191-194.

Descriptors: *Cleanup operations, *Contaminated sediments, *Hazardous wastes, *Dredging, Classification, Pilot studies, Field tests.

Realizing the need to improve the capabilities of response personnel in dealing with cleanup operations involving contaminated sediments, the US Coast Guard and the US EPA have jointly funded a research project to: (a) identify, characterize, and classify chemicals that sink in watercourses and are amenable to recovery by dredging and/or other techniques such as in-situ treatment; (b) review the state of the art of contaminated sediment management technology to document and identify improved methodologies for handling and disposing of contaminated sediments; (c) implement pilot-scale studies on recommended modified approaches identified under the state-of-the-art work; and (d) perform field demonstrations of methods and equipment developed. The first two activities under this program have been completed. A database was developed based on the Chemical Hazards Response Information System. The resulting Hazardous Sinkers List contains 468 chemicals. Existing technologies, such as those from the construction, dredging, mining, wastewater treatment, spill response, and hazardous waste management industries, are applicable to contaminated sediments management. (See also W88-01522) (Lantz-PTT)
W88-01543

PREVENTION OF WATER POLLUTION AND PLAN FOR THE EXPLOITATION OF THE ASH TIP OF THE LA ROBLA CONVENTIONAL POWER STATION,
EPTISA-GHESA-TRSA-Empresarios Agrupados, Madrid (Spain).
For primary bibliographic entry see Field 5E.
W88-01555

HYDROGEOLOGICAL CONDITIONS FOR LEACHATE PRODUCTION CONTROL IN A SULFIDE MINE TAILING,
Uppsala Geosystem A.B. (Sweden).
C. L. Axelsson, L. Karlqvist, and T. Olsson.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 615-622, 4 fig, 2 ref.

Descriptors: *Water pollution prevention, *Water quality control, *Acid mine water, *Geohydrology, *Sulfides, *Leachates, Mine wastes, Sweden, Snow, Infiltration, Precipitation.

Leachate of contaminated water from sulfide mine residual products is a great environmental problem in Sweden. An investigation was carried out to minimize leachate production from the residual products by means of covering the deposits with natural soil materials. The study shows that natural soil types have such a high infiltration capacity, that no significant sealing effects are obtained. It is only possible to reduce the infiltration at periods with intense precipitation or rapid melting of snow, and then only the peaks in the leachate production are affected. Nevertheless, the sealing and covering layers on the top of a deposit are of great importance as water reservoirs and thus increase the evapotranspiration losses. (See also W88-01554) (Author's abstract)
W88-01556

MIGRATION AND CONTAINMENT OF LEACHANTS FROM URANIUM TAILINGS PONDS,
Carleton Univ., Ottawa (Ontario). Inst. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W88-01557

SUBMODELS OF WATER QUALITY FOR THE ANALYSIS OF REGIONAL WATER POLICIES IN OPEN-PIT LIGNITE MINING AREAS,
Technische Univ., Dresden (German D.R.). Inst. of Lignite Mining.
J. Hummel, R. Fischer, L. Luckner, and S. Kaden.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 673-684, 5 fig, 1 tab, 10 ref.

Descriptors: *Water quality, *Public policy, *Water pollution control, *Computer models, *Lignite mines, *East Germany, Mine water, Water quality control, Iron, Water treatment, Model studies, Groundwater quality.

An approach to water quality submodels for the analysis of regional water policies in open-pit lignite mining areas is outlined, with special regard to a test region in the German Democratic Republic. Reduced conceptual water quality models have been developed for the concentrations of the substances Fe(2+) and H(+) in mine water treatment plants, rivers and remaining pits. The resulting system of differential equations is solved numerically. The methodology used to obtain simplified models of groundwater and surface water quality processes suitable for decision support model systems for regional water policies in open-pit lignite mining areas is assumed to be applicable to similar regional studies. (See also W88-01554) (Author's abstract)
W88-01561

SYNERGETIC APPROACH TO CONTROL ACID MINE DRAINAGE: A MICHIGAN CASE HISTORY,
Michigan Technological Univ., Houghton. Inst. of Mineral Research.
A. M. Johnson.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 695-708, 7 fig, 1 tab, 8 ref.

Descriptors: *Water pollution control, *Mine wastes, *Acid mine drainage, *Michigan, *Case studies, *Path of pollutants, Water quality control, Acidic water, Leaching, Pumping, Water pollution sources, Economic aspects.

Acid drainage was a problem associated with iron ore mining on the West Menominee Range in northern Michigan. With the cessation of mining in the last decade, it was generally assumed that acid drainage would cease. For most mines this was true, however, upon flooding, acid from several of them began flowing into the surface drainage with resulting pollution problems. Hydrologic studies showed that most of the drainage originated from acid in the mine pool with lesser amounts from surface leaching of pyritic waste rock piles. The average rate of flow was low (3-8 l/sec), but given the large volume of the acid reservoir it was deter-

mined that acid drainage would be a problem for many decades. Pumping was investigated as a means to halt the acid flow but because of high costs was not implemented. Subsequent tests demonstrated that nearby river water had more than adequate capacity to neutralize the acid and that only a small percentage of the river water was needed to neutralize the acid and cause precipitation of the metals. Based upon these results, a plan to 'treat' the acid water by diverting river water into the mine pit was proposed. Further settling would occur as the waters flow through a series of natural ponds which lie downslope from the mine. A clear effluent would be returned to the river about one kilometer downstream. Basically this system utilizes the same mechanisms that are presently occurring in the river; i.e., neutralization and metal precipitation, but under controlled conditions. This synergetic approach is viewed as an attractive low-cost method for abating acid drainage in Michigan. It may have application in other areas. (See also W88-01554) (Author's abstract)
W88-01563

PLANNING AND DESIGN OF COAL WASTE DISPOSALS IN VIEW OF GROUNDWATER PROTECTION,
J. Libicki.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 723-735, 1 fig, 4 ref.

Descriptors: *Water quality control, *Coal mines, *Mine wastes, *Groundwater pollution, *Waste management, *Waste disposal, Water pollution prevention, Aquifers, Monitoring, Groundwater quality, Disposal sites.

Disposal of coal waste and coal fired powerplant ash in an environmentally acceptable way is very important. These wastes have polluting potential due to the content of leachable components which can migrate to aquifers. Different types of coal wastes and testing methods are discussed from the viewpoint of disposal. Different types of disposal sites include over-terrain disposal; 'dry' disposal (below terrain level but above the groundwater table); and 'wet' disposal sites (below terrain level and below the groundwater table). Recommendations for planning and design of safe disposal are proposed, as well as planning of groundwater monitoring around disposal sites. An example design of a large disposal with full groundwater protection is presented. (See also W88-01554) (Lantz-PTT)
W88-01565

MODELING OF MIGRATION PROCESSES WITH COUPLED MIGRANTS AND THEIR REDUCTION TO CONTROL MODELS,
Technische Univ., Dresden (German D.R.). Inst. of Lignite Mining.
L. Luckner.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 737-748, 4 fig, 8 ref.

Descriptors: *Water quality control, *Model studies, *Path of pollutants, *Water pollution prevention, Mine water, Mine wastes, Water policy, Lignite mines, Water treatment, Acid mine drainage.

The development of complex decision support model systems for the analysis of regional water policies for regions with intense development affecting and being affected by the water resources system is of increasing importance. Some of the best illustrations are regions with open-pit lignite mining. Such systems have to be studied using appropriate submodels for water quality processes. Discharge of acid ferruginous mine water into rivers is considered to have the most important impact on water quality in open-pit lignite mining areas. One goal of the model system is the choice of the necessary degree of purification for mine water treatment plants, taking into account self-purification in rivers as well as the water quality demand of downstream users. The state-of-the-art of comprehensive water quality models is described with special regard to lignite mining areas. Based on these descriptions approaches for model reduction are outlined. (See also W88-01554) (Lantz-PTT)
W88-01566

HYDROGEOLOGIC ASPECTS OF THE ABANDONMENT OF AN UNDERGROUND LEAD-ZINC MINE,
Idaho Univ., Moscow. Coll. of Mines and Earth Resources.
For primary bibliographic entry see Field 4B.
W88-01570

USE OF CONTROLLED RELEASE BACTERICIDES FOR RECLAMATION AND ABATEMENT OF ACID MINE DRAINAGE,
Goodrich (B.F.) Co., Akron, OH.
A. A. Sobek, M. A. Sheilhorn, and V. Rastogi.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 817-827, 6 fig, 3 tab, 8 ref.

Descriptors: *Water pollution control, *Bactericides, *Acid mine drainage, *Water pollution treatment, *Water quality control, *Wastewater treatment, Thiobacillus ferrooxidans, Biological treatment, Reclamation, Polymers, Acidity, Iron, Aluminum, Manganese, Sulfates.

Oxidation of pyritic materials in mine tailings, refuse piles and spoil is catalyzed by the bacteria Thiobacillus ferrooxidans which, below a pH of 3, accelerate oxidation kinetics by a factor of five to ten. Several chemical agents have been demonstrated to inhibit T. ferrooxidans. However, the effectiveness of these bactericides is material specific. Laboratory techniques were developed to determine which bactericide would provide the greatest economic benefit for an individual site. Spray applications of bactericides can be used for short term acid abatement in active operations. For reclamation, a dispersed monolithic controlled release system was developed. This system provides active agent in required concentrations for periods of three to five years to permit growth of vegetation using minimal quantities of topsoiling materials. Bactericide release rate is controlled by the polymer matrix and by the size of the monolithic pellets. The pellets are applied by a hydroseeder in a one-step operation which distributes pellets and sprays a bactericide solution. Spray solutions initiate rapid bacteria inhibition and overcome overburden adsorption capacity, while pellets provide long-term control. The system is applied after rough grading of disturbed materials and then covered by topsoiling material. Four refuse piles in the Appalachian region of the United States were reclaimed in 1984. Water quality improvement of 82% to 95% over control were obtained for acidity, iron, aluminum, manganese and sulfates. Significant loss of vegetation due to acid burnout occurred on the control areas while treated areas support a vigorous vegetation. (See also W88-01554) (Author's abstract)
W88-01572

GROUND-WATER REACTIONS TO SURFACE COAL MINING IN SEMIARID LANDS,
Montana Bureau of Mines and Geology, Butte.
For primary bibliographic entry see Field 4C.
W88-01576

MAIN DEWATERING OF MINES NEW COST SAVING TECHNIQUES,
Flygt A.B., Solna (Sweden).
For primary bibliographic entry see Field 4B.
W88-01578

MINE DEWATERING DESIGN IN SURFACE MINING TO IMPROVE THE QUALITY OF GROUND WATER,
Universidad Politecnica de Madrid (Spain). Escuela Tecnica Superior de Ingenieros de Minas.
For primary bibliographic entry see Field 4B.
W88-01581

MINE WATER - A RESOURCE FOR TRANSPORTATION OF ORES FROM UNDERGROUND MINES,
Luleaa Univ. (Sweden). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 3C.
W88-01589

RECLAMATION AND REDEVELOPMENT OF CONTAMINATED LAND: VOLUME I, U.S. CASE STUDIES,
Research Triangle Inst., Research Triangle Park, NC.
For primary bibliographic entry see Field 5E.
W88-01606

PLATING WASTE TREATMENT,
For primary bibliographic entry see Field 5D.
W88-01653

ENVIRONMENTAL LAW HANDBOOK,
J. G. Arbuckle, M. A. Brown, N. S. Bryson, G. W. Frick, and R. M. Hall.
Government Institutes, Inc., Rockville, MD. Eighth Edition, 1985. 586 p.

Descriptors: *Legal aspects, *Water law, *Environmental law, Resource Conservation and Recovery Act, Comprehensive Environmental Response Compensation and Liability Act, Toxic substances, Safe Drinking Water Act, Air pollution, Water pollution control, National Environmental Policy Act, Pesticides, Regulations.

A complex body of environmental laws, regulations, and decisions is now established in the United States. Environmental law, which evolved quickly, now ranks with labor, tax, banking, communications, and several other fields as an accepted part of our legal system. The chapters in this book present the various aspects of environmental law: (1) Common Law; (2) Resources Conservation and Recovery Act; (3) Comprehensive Environmental Response, Compensation and Liability Act (SUPERFUND); (4) Toxic substances; (5) Safe Drinking Water Act; (6) Air Pollution Control; (7) Water Pollution Control; (8) The Occupational Safety and Health Act; (9) National Environmental Policy Act; (10) Federal Regulation of Pesticides; (11) Marine Protection, Research and Sanctuaries Act; (12) Noise Control; (13) Land Use: Major Issues in the Control of Industrial Development; and (14) Enforcement and Liabilities. (Lantz-PTT)
W88-01654

GROUND WATER QUALITY PROTECTION,
Oklahoma Univ., Norman. Environmental and Ground Water Inst.
L. W. Canter, R. C. Knox, and D. M. Fairchild.
Lewis Publishers, Inc., Chelsea, MI. 1987. 562 p.

Descriptors: *Groundwater quality, *Water quality control, *Water pollution prevention, Groundwater management, Water pollution sources, Water pollution control, Groundwater pollution, Cleanup operations, Water quality management.

Many groundwater quality management programs are being developed within federal agencies, state and local governments, and the private sector. The planning and implementation of these programs should be based on sound technical information and knowledge, and this book can be considered as a resource document to aid in the process. This book is organized into 11 chapters, with the first three containing basic information, Chapters 4-9 addressing groundwater pollution sources and their evaluation, and Chapter 10 and 11 focusing on pollution control and cleanup and groundwater quality management. (Lantz-PTT)
W88-01655

ENVIRONMENTAL ENGINEERING AND SANITATION,
For primary bibliographic entry see Field 5D.
W88-01659

WATER QUALITY MODELING: A REVIEW OF THE ANALYSIS OF UNCERTAINTY,

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
M. B. Beck.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1393-1442, August 1987. 17 fig, 269 ref.

Descriptors: *Uncertainty analysis, *Mathematical studies, *Model studies, *Data interpretation, *Mathematical models, *Water quality, Reviews, Mathematical equations, Water quality models, Prediction.

The role of uncertainty in the identification of mathematical models of water quality and in the application of these models to problems of prediction is reviewed. Four problem areas are examined in detail: uncertainty about model structure, uncertainty in the estimated model parameter values, the propagation of prediction errors, and the design of experiments in order to reduce the critical uncertainties associated with a model. An impression of the current and future issues in the analysis of uncertainty in water quality modeling is given. Sections are also included dealing with: (1) identifiability and experimental design, (2) the generation of preliminary model hypotheses under conditions of sparse, grossly uncertain field data, (3) the selection and evaluation of model structure, (4) parameter estimation (model calibration), (5) checks and balances on the identified model, and (6) prediction error propagation. The algorithms of system identification, in particular, the methods of recursive estimation, are discussed and related to the subject of identification to the problems of prediction uncertainty and first-order error analysis. Serious omissions from this review include development and solution of stochastic differential equations and the issue of decision making under uncertainty. It is concluded that much work has been done on the analysis of uncertainty in the development of mathematical models of water quality and that much remains to be done. A lack of model identifiability has been an outstanding difficulty in the interpretation and explanation of past observed system behavior, and there is ample evidence to show that the 'larger,' more 'comprehensive' models are easily capable of generating highly uncertain predictions of future behavior. For the future of the subject, it is speculated that there is the possibility for progress in the development of novel algorithms for model structure identification, a need for new questions to be posed in the problem of prediction, and a distinct challenge to the conventional views in the forms of knowledge representation and manipulation now emerging in the field of artificial intelligence. (Wood-PTT)
W88-01675

PROFIENCY TESTING OF WATER MICROBIOLOGY LABORATORIES IN THE NETHERLANDS,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.
A. H. Havelaar, W. M. Hogeboom, V. M. Sekhuis, and E. H. W. van Erne.
Journal of Applied Bacteriology JABAA4, Vol. 62, No. 6, p 535-564, June 1987. 4 fig, 7 tab, 15 ref. Netherlands Ministry of Housing, Physical Planning and Environmental Hygiene Project RIVM 148136.

Descriptors: *Water quality control, *Evaluation, *Water quality, *Bacterial analysis, *Pollutant identification, *Proficiency testing, Water quality standards, Netherlands, Biological samples, Water analysis, Coliforms, Bacteria, Statistical analysis, Microbiological studies.

In a 3-year period, four series of simulated water samples containing selected test strains were distributed to more than 50 laboratories in The Netherlands for bacteriological testing. Participating laboratories examined the samples by enrichment or membrane filtration methods, or both, for total coliform organisms, thermotolerant coliform organisms, fecal streptococci and standard plate counts (37 C and 22 C) according to Dutch standard methods. The results were quantitatively satisfactory: the distribution of positive and negative results with subsamples conformed to stochastic variation; the standard deviation of membrane or plate counts was usually in the range which may be expected from a Poisson distribution, and there was good correspondence between average counts in participating laboratories and those expected from controls in the organizing laboratory. Problems of a qualitative nature were frequently encountered, however. Among them were a false positive response with a strain of Enterobacter cloacae in the thermotolerant coliform test; a false positive result with Clostridium perfringens in enrichment tests for total or thermotolerant coliform organisms and false positive results with Micrococcus varians in the fecal streptococcus test by membrane filtration. It is concluded that quality assessment should be a consistent activity in water microbiology laboratories. For this purpose, stable and well characterized reference materials are needed. (Author's abstract)
W88-01710

AGRICULTURAL CHEMICALS IN GROUND WATER: SUGGESTIONS FOR THE ENVIRONMENTAL PROTECTION AGENCY STRATEGY,
Kansas State Univ., Manhattan. Inst. for Environmental Research.
For primary bibliographic entry see Field 5B.
W88-01714

PERSISTENCE OF SYNTHETIC SOLVENT CONTAMINANTS IN A GLACIAL OUTWASH AQUIFER, WASHINGTON STATE,
Environmental Protection Agency, Seattle, WA. Region X.
For primary bibliographic entry see Field 5B.
W88-01734

PREVENTION AND CONTAINMENT OF HAZARDOUS/TOXIC MATERIALS SPILLS IN DEPARTMENT OF DEFENSE STORAGE AND HANDLING AREAS,
Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD.
For primary bibliographic entry see Field 5E.
W88-01736

TOXIC ORGANIC BEHAVIOR IN SLUDGE-AMENDED SOILS,
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5B.
W88-01737

BENNETT'S QUARRY: A CASE STUDY OF AN IMMEDIATE REMOVAL OF PCB WASTES UNDER SUPERFUND,
Weston (Roy F.), Inc., Northbrook, IL. SPER Div.
For primary bibliographic entry see Field 5E.
W88-01741

CONTAINMENT OF IRON SULFATE FROM ABANDONED PICKLE LIQUOR PONDS INVESTIGATION, FEASIBILITY STUDY DESIGN AND CONSTRUCTION,
Donohue and Associates, Inc., Sheboygan, WI.
For primary bibliographic entry see Field 5E.
W88-01742

LIQUID DISPOSAL, INCORPORATED: A $2.2 MILLION SUPERFUND IMMEDIATE REMOVAL ACTION,
Weston (Roy F.), Inc., Northbrook, IL. SPER Div.
For primary bibliographic entry see Field 5E.
W88-01743

SITE SAFETY AT THE MIDDLETOWN ROAD REMOVAL,
Geo/Resource Consultants, Inc., Washington, DC.
For primary bibliographic entry see Field 5E.
W88-01744

MONITORING AN IMPLEMENTED REMEDIAL ACTION,
Conestoga-Rovers and Associates, Waterloo (Ontario).
For primary bibliographic entry see Field 5E.
W88-01745

REGULATION OF UNDERGROUND CHEMICAL STORAGE TANKS IN THE SAN FRANCISCO BAY AREA,
California Regional Water Quality Control Board, Oakland. San Francisco Bay Region.
For primary bibliographic entry see Field 5B.
W88-01748

AVOIDING FAILURE OF LEACHATE COLLECTION SYSTEMS AT HAZARDOUS WASTE LANDFILLS,
Little (Arthur D.), Inc., Cambridge, MA. Hazardous Waste Management Unit.
For primary bibliographic entry see Field 5E.
W88-01749

SANITARY LANDFILL LINERS - AN OVERVIEW OF REGULATORY REQUIREMENTS AND ENGINEERING PRACTICES,
Land and Lakes Co., Park Ridge, IL.
For primary bibliographic entry see Field 5E.
W88-01750

WATER AND THE MICHIGAN ECONOMY: MANAGING WATER QUALITY,
Michigan State Univ., East Lansing. Dept. of Agricultural Economics.
J. T. Kovan, L. W. Libby, and J. P. Hoehn.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 217196/AS. Price codes: A03 in paper copy, A01 in microfiche. Michigan Institute of Water Research, E. Lansing, Technical Report No. G1232-03, March 1987. 36 p, 2 fig, 46 ref. Contract No. 14-08-0001-G1232. Project No. USGS 11232-03.

Descriptors: *Public policy, *Groundwater quality, *Economic aspects, *Michigan, *Water quality control, Water quality, Pollution taxes, Nonpoint sources, Permits, Zoning, Land classification.

A situation, structure, and performance model is used to analyze policy alternatives for managing groundwater quality in Michigan. The study focuses on policy alternatives that may be used to control non-point sources in nitrate leachates. The area-specific nature of this groundwater problem suggests an important regulatory role for State and local governments. State and Federal efforts are also important in providing a scientifically sound information base for actions by local governments. Nine sets of policy instruments are examined: permitting, taxes, zoning, land classification systems, liability rules, penalties, market bargaining, direct acquisition, and education. Legal liability, land classification, and education are the policy tools currently in use. Rural zoning and direct acquisition of development rights are likely to be very effective in protecting sensitive groundwater recharge areas. Permitting and taxes may be effective instruments in controlling nitrate effluents across large geographic areas. The direct and indirect economic costs of permitting and targeted taxes are likely to be high. (MI St. U.)
W88-01758

DYNAMICS OF BLUE-GREEN ALGAL (MICROCYSTIS AERUGINOSA) BLOOMS IN THE LOWER NEUSE RIVER, NORTH CAROLINA: CAUSATIVE FACTORS AND POTENTIAL CONTROLS,
North Carolina Univ. at Chapel Hill. Inst. of Marine Sciences.
For primary bibliographic entry see Field 5C.
W88-01761

CRITICAL ASSESSMENT OF THE INFLUENCE OF MANAGEMENT PRACTICES ON WATER QUALITY, WATER TREATMENT, AND SPORT FISHING IN MULTIPURPOSE RESERVOIRS IN KANSAS,

Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 6G.
W88-01764

METHOD OF IN-SITU LEACHING OF ORES,
ISL Ventures, Inc., San Francisco, CA.
R. V. Huff, S. G. Axen, and D. R. Baughman.
U.S. Patent No. 4,634,187; January 6, 1987. 8 p, 10 fig, 3 ref. Official Gazette of the United States Patent Office, Vol 1074, No 1, p 251-252, January 6, 1987.

Descriptors: *Patents, *Leaching, *Impervious boundaries, *Groundwater barriers, *Water pollution control, *Minerals, Migration, Lixiviant, In situ tests, Drilling, Polymers, Encapsulation.

In situ leaching of mineral values is achieved by encapsulating the ore value within impermeable barriers to confine the migration of lixiviant to control its loss and potential pollution of groundwater. Vertical barriers are formed by drilling a ring of boundary wells around the desired portion of the ore body. The strata surrounding each boundary well may be fractured, if necessary. The surrounding strata are saturated with a polymer or other impermeable material that is injected into each boundary well. Horizontal barriers are formed as part of the process of drilling and completing the injection and production wells that are later used for in-situ leaching. An overlapping grid of horizontally-oriented fractures is created above and below the ore body and radiating from each of the injection and production wells. The fractures and some of the adjacent rock are filled with a polymer or other material suitable for forming an impermeable barrier. Sections of the vertical and horizontal barriers may be omitted in those areas where the strata surrounding the ore body are relatively impermeable. (Cremmins-AEPCO)
W88-01778

PROCESS OF SAFELY DISPOSING OF WASTE MATERIALS,
For primary bibliographic entry see Field 5E.
W88-01782

STORAGE POND,
British Nuclear Fuels Ltd., Warrington (England).
For primary bibliographic entry see Field 5E.
W88-01783

DREDGE ENVIRON PROTECTION ASSEMBLY,
F. A. Smith.
U.S. Patent No. 4,386,872; June 7, 1983. 9 p, 12 fig. Official Gazette of the United States Patent Office, Vol 1031, No 1, p 156, June 7, 1983.

Descriptors: *Patents, *Water pollution prevention, *Dredging, *Sediments, *Dredge spoil, Barges, Bottom sediments, Caissons.

A barge-mounted assembly isolates waterways during dredging to prevent disturbed sediment from spreading. The barge-mounted dredge protection assembly is floated to the dredging area. Column caissons are lowered from the barge into portions of the channel bottom at distances sufficient to support the barge above the channel bottom without the aid of water within the channel. The column caissons thus function as stilts for supporting the barge above the bottom surface of the channel. Separate panel support columns are also lowered from the barge into the channel or river bottom to a depth that resists water pressure acting on the panel members extending between each pair of adjacent panel support columns. After the panel support columns are in position, side panels are lowered end-to-end into the water until they completely surround the barge to enclose and isolate the water within the dredging area. Seals located between the side panels and the panel support columns ensure a fluid-tight enclosure is created. After dredging operations, water is reintroduced into the area and the side panels and support columns are withdrawn. (Cremmins-AEPCO)
W88-01784

METHOD FOR CONTAINING OIL AND/OR GAS WITHIN A BLOW-OUT COVER DOME,
Dome Petroleum Ltd., Calgary (Alberta).
C. O'Rourke, and R. Pilkington.
U.S. Patent No. 4,405.258; September 20, 1983. 8 p, 5 fig. Official Gazette of the United States Patent Office, Vol 1034, No 3, p 1091, September 20, 1983.

Descriptors: *Patents, *Water pollution control, *Blowouts, *Oil wells, *Water pollution prevention, Oil pollution, Impervious membranes, Drainage systems, Offshore platforms.

Environmental pollution is controlled by containing oil generated by an underwater blowout of an oil and gas well within an offshore oil-containment dome. The dome contains an upper expanded dome-like fluid impervious membrane, a fluid impervious hollow peripheral ring attached to the periphery of the membrane to provide a bag-like container, and a water drainage system within the container for connection to a pump conduit system. Drained sand from the seabed is pumped into the bag-like container; thereby providing the hollow peripheral ring as a self-supporting hollow peripheral torus and as an anchor for the dome-like unit. The containment dome is charged with a buoyant amount of air and the buoyed dome is floated out to the side where the containment dome is to be located. The containment dome is submerged by controllably releasing the air while filling the dome with water, thereby sinking it until the peripheral hollow torus rests on the seabed at predetermined locations. The lighter-than-water fluid in the dome is captured while simultaneously displacing water from within the dome with the lighter than-water fluid. (Cremmins-AEPCO)
W88-01785

BAYESIAN ANALYSIS OR SCIENTIFIC JUDGMENT OF UNCERTAINTIES IN ESTIMATING RISK DUE TO RN-222 IN U.S. PUBLIC DRINKING WATER SUPPLIES,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. J. Crawford-Brown, and C. R. Cothern.
Health Physics HLTPAO, Vol. 53, No. 1, p 11-21, July 1987. 1 fig, 2 tab, 36 ref.

Descriptors: *Drinking water, *Health effects, *Radioisotopes, *Water quality, *Statistical analysis, *Radon, *Water pollution effects, Estimating, Statistical methods, Environmental policy, Risks, Air pollution effects, Carcinogens, Administrative regulations.

The elements which contribute to the range of values or uncertainties for the lifetime risk and dose equivalent due to Rn-222 in U.S. public drinking water supplies are estimated and discussed. From imperfect scientific knowledge, reasonable upper and lower bounds are placed on these estimates through the use of a semi-quantitative Bayesian approach to uncertainty analysis. The factors considered are: occurrence of Rn-222 in drinking water, indoor air Rn-222 concentrations as a function of drinking water concentration, equilibrium state of the progeny, fraction of daughter products attached to aerosol particles, anatomical and dosimetric variables, epidemiological studies and choice of latency period, plateau period and effects of age. For Rn in U.S. public drinking water supplies, it is estimated that the best estimate for the lifetime lung cancer risk factor is 5 x 10 to the minus 9th power excess cases of lung cancer/becquerel of Rn/cu m of water (.0000002 excess cases of lung cancer/picocurie of Rn/L of water), with an estimated range between 2 x 10 to the minus 9th power and 2 x 10 to the minus 8th power excess cases/becquerel of Rn/cu m of water (5 x 10 to the minus 8th power and .0000007 excess cases/picocurie of Rn/L). The best estimate of the lifetime population risk due to Rn-222 in U.S. public drinking water supplies is estimated to be 6000 excess lung cancers, with a reasonable range of 1000 to 30,000. (Author's abstract)
W88-01810

ALERTING ENGINEERS TO NEW EPA SAFE WATER REGULATIONS,
CWC-HDR, Inc., Edmonds, WA.
G. Culp.
Consulting-Specifying Engineer, Vol. 1, No. 6, p 54-59, June 1987. 2 tab.

Descriptors: *Water quality control, *Drinking water, *Legislation, *Regulations, Liability, Water quality, Water treatment, Lead, Pollutants, Bacteria, Organic compounds.

The 1986 amendments to the Safe Water Drinking Act will greatly impact the drinking water industry. Regulated contaminants (those for which allowable concentrations have been established) will be increased from the current number (22) to a total of 105 by 1989, with the requirement that still more contaminants be added to the list in later years. A further change, regarding the maximum contaminant level goal (MCLG) and the maximum contaminant level (MCL), may introduce a liability dilemma for water system designers and owners. Revised lead levels, increased requirements for filtration, and a requirement that all water supplies be disinfected are also included (some groundwater supplies may be exempted from disinfection under final rules to be promulgated by June 1989). Some municipal water systems and state agencies have already responded to the draft regulations requiring increased filtration. There are steps that can be taken to prepare for the effects of the implementation of the amendments, and include: (1) assess monitoring and data gathering programs; (2) educate policy makers and the public; and (3) identify system improvements. (Airone-PTT)
W88-01812

ENVIRONMENTAL POLICY IN POST-MAO CHINA,
For primary bibliographic entry see Field 6E.
W88-01813

RELATIONSHIP OF UPPER LETHAL TEMPERATURES TO SILICON CONTENT IN ECOLOGICALLY DIFFERENT HYDROBIONT SPECIES FROM CONTINENTAL WATERS,
Akademiya Navuk BSSR, Minsk. Inst. of Zoology.
For primary bibliographic entry see Field 6G.
W88-01819

IMPACT OF EPA'S BIOMONITORING POLICY ON POTWS,
Colorado Springs Dept. of Utilities, CO.
M. M. Grimes.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 8, p 755-760, August 1987. 2 tab, 4 ref.

Descriptors: *Regulations, *Monitoring, *Wastewater treatment facilities, *Water quality control, Toxicity, Permits, Licenses, Bioassays, Wastewater treatment, Costs, Water pollution control, Policy making, Water quality standards, Public policy.

The U.S. Environmental Protection Agency (EPA) has adopted a policy that will begin to hold regional offices and the states formally accountable for the implementation of biological toxics control over the next two years. Several thousand new and renewed permits will include toxicity limits and effluent toxicity monitoring requirements. The new policy thus shifts the biomonitoring scheme which had been in use for direct industrial discharges to all POTWs via the permit process. This is a major policy change. Serious technical, procedural, and legal difficulties exist in this direct conversion of industrial methodology to POTWs. A 2-year enactment schedule may not allow time for proper review by water pollution control professionals. Technical, policy, and implementation issues which must be resolved are discussed. In addition, an alternative proposal for control of toxic substances in POTW discharges is described. Mutual development and refinement by both EPA and the regulated community must precede implementation of biomonitoring if the full potential of this

water pollution control method is to be realized. (Airone-PTT)
W88-01823

IMPLEMENTATION OF A WATER QUALITY-BASED STRATEGY FOR PROTECTION OF AQUATIC LIFE,
Connecticut Dept. of Environmental Protection, Hartford.
L. E. Dunbar.
Water Pollution Control Federation Journal JWPFA5, Vol. 59, No. 8, p 761-766, August 1987. 2 tab, 20 ref.

Descriptors: *Water quality control, *Regulations, *Costs, *Water quality standards, *Water quality management, Water pollution control, Industrial wastewater, Toxins, Water quality, Effluents, Monitoring, Wastewater treatment.

Water quality-based effluent limits (as opposed to limits based on available treatment technology) are becoming more common throughout the U.S. In comparison to technology-based limits, water quality-based limits are significantly more difficult and resource-intensive to develop and implement. Since individual states are given primary responsibility for developing water quality standards under the Federal Clean Water Act, state and regional program administrators are faced with the challenge of developing and implementing a permitting program. In Connecticut, a state with a diverse mix of wastewater sources, a technology-based requirement for water quality has been used successfully in the past. Recently, that state's Department of Environmental Protection adopted an integrated strategy for water quality-based permitting of toxic pollutant discharges into surface waters. The article discusses the program and describes three case studies, including the results and the varied costs of each case. (Airone-PTT)
W88-01824

CONTROL OF EUTROPHICATION OF LAKES AND RESERVOIRS BY MEANS OF PRE-DAMS. I. MODE OF OPERATION AND CALCULATION OF THE NUTRIENT ELIMINATION CAPACITY,
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
J. Benndorf, and K. Putz.
Water Research WATRAG, Vol. 21, No. 7, p 829-838, July 1987. 10 fig, 3 tab, 26 ref.

Descriptors: *Water quality control, *Eutrophication, *Lakes, *Reservoirs, *Pre-dams, *Nutrients, Algae, Orthophosphate, Retention, Nitrogen, Phosphorus, Mathematical studies, Retention time.

Pre-dams are small reservoirs having an average theoretical water retention time of a few days. They are situated immediately above the larger main reservoir (or lake), whose nutrient loading it is their purpose to reduce. Since nutrient uptake by algae and sedimentation are the dominating processes of the nutrient removal in pre-dams, the following demands to the design, construction, and operation should be taken into consideration: (1) relatively low mean depth; (2) surface release; and (3) optimum size. A calculation procedure for the mean monthly rates of orthophosphate elimination is described, which makes it possible to predict the orthophosphate elimination of designed pre-dams of a particular size. This procedure is the basis for the optimization of the size of the pre-dam. The elimination capacity with respect to inorganic nitrogen can be roughly estimated from the mean residence time of the water and the N:P ratio. The described method involves 10 year's experience with its application. (See also W88-01845) (Author's abstract)
W88-01844

CONTROL OF EUTROPHICATION OF LAKES AND RESERVOIRS BY MEANS OF PRE-DAMS. II. VALIDATION OF THE PHOSPHATE REMOVAL MODEL AND SIZE OPTIMIZATION,
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
J. Benndorf, and K. Putz.
Water Research WATRAG, Vol. 21, No. 7, p 839-842, July 1987. 3 fig, 2 tab, 13 ref.

Descriptors: *Water quality control, *Eutrophication, *Lakes, *Reservoirs, *Pre-dams, *Phosphates, Model studies, Mathematical studies, Orthophosphates, Phosphorus, Nutrients, Nonpoint pollution sources, Water pollution control, Retention time.

A calculation procedure for the mean monthly rates of orthophosphate elimination in pre-dams was presented in the first paper of this study. The validity of this model is checked by means of 17 data sets from 15 existing pre-dams. The calculated and observed elimination rates exhibit a rather high degree of accordance. The application of the model makes it possible: (1) to predict the orthophosphate elimination of designed pre-dams of a particular size and (2) to determine the optimum size of a pre-dam that results in the required rate of P-elimination. Both these possibilities are prerequisites to a proper selection and combination of the various measures of eutrophication control. When eliminating the nutrients in pre-dams the disadvantage as compared to other possible measures for controlling nonpoint sources of phosphorus and nitrogen is, that the efficiency, on an annual average, is relatively low (PO4-P: approximately 60% at optimum size and in a temperate climate), but the decisive advantage of pre-dams is the minimum operating expenses. (See also W88-01844) (Author's abstract)
W88-01845

USE OF THE ALGAL GROWTH POTENTIAL TEST FOR DATA ASSESSMENT,
Environmental Protection Agency, Athens, GA. Environmental Services Div.
For primary bibliographic entry see Field 5A.
W88-01855

ERODIBLE LAND AND STATE WATER QUALITY PROGRAMS: A LINKAGE,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
C. W. Ogg.
Journal of Soil and Water Conservation JSWCA3, Vol. 41, No. 6, p 371-373, November-December 1986. 18 ref.

Descriptors: *Erosion, *Water conservation, *Regulations, Legislation, Conservation Resource Program, Agriculture, Water quality control, Nonpoint pollution sources.

State interest in the new Conservation Resource Program (CRP) exists wherever highly erodible cropland is implicated in water quality problems. These erosion-related water problems were identified by state and local water quality planning programs in the 1970s. States are expected to encourage target groups of farmers to enroll in the CRP as a logical extension of linkages between state and federal conservation efforts that already exist. Virtually all state nonpoint pollution control efforts linked to federally funded conservation programs. Particular interest in the new CRP stems from its size and its focus on the most conspicuous erosion problems. The temporary nature of this multibillion dollar program lends urgency to the task of implementing nonpoint pollution programs. States that delay action until market prices improve may miss the CRP cost-sharing opportunities. Higher farm prices could make it prohibitively expensive to address erosion-related pollution problems on the highly erodible land that accounts for much of the problem. The conservation title of the farm bill thus offers a challenge as well as an opportunity. (Lantz-PTT)
W88-01883

ENVIRONMENTAL IMPACT ANALYSIS AS RELATED TO RIVER BASIN MANAGEMENT,
Pennsylvania Univ., Philadelphia. Dept. of Systems Engineering.
For primary bibliographic entry see Field 6G.
W88-01886

SURVIVAL OF FATHER RHINE,
Michigan Univ., Ann Arbor. School of Public Health.
For primary bibliographic entry see Field 5B.
W88-01891

REMOVAL OF TASTE-AND ODOR-CAUSING COMPOUNDS BY BIOFILMS GROWN ON HUMIC SUBSTANCES,
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
For primary bibliographic entry see Field 5F.
W88-01895

CONSIDERATIONS INVOLVED IN THE REACTIVATION OF AN EXISTING WATER SUPPLY,
Massachusetts Water Resources Authority, Boston. Waterworks Div.
For primary bibliographic entry see Field 5F.
W88-01898

TOXICOLOGY OF ORGANIC MICROPOLLUTANTS IN DRINKING WATER: ESTIMATING THE RISK,
Water Research Centre, Medmenham (England).
S. M. Hunt, and J. K. Fawell.
Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 41, No. 3, p 276-284, June 1987.

Descriptors: *Toxicology, *Water quality, *Microbiological studies, *Water pollution effects, *Drinking water, Epidemiology, Bioassay, Pollutant identification, Model studies, Toxicity, Organic compounds, Public health, Health effects.

Three approaches have been used to assess whether a hazard to health exists and what risk may be posed by organic micropollutants in drinking water: (i) epidemiology; (ii) bioassays (such as the Ames mutagenicity test); and (iii) identification of individual compounds and evaluation of available toxicological data. The use of epidemiology and bioassays is reviewed briefly but evaluation of toxicological data on compounds identified in drinking water is discussed in more detail. A major difficulty is that the compounds identified in drinking water constitute only a small fraction of the organic matter present. Moreover, there are only limited toxicological data available on these compounds. Evaluation of compounds shown to be carcinogenic in experimental animals is very problematic with respect to both the toxicological data and the choice of risk extrapolation model. Difficulties in evaluating some specific drinking water micropollutants (e.g., chloroform, carbon tetrachloride, the phthalates) are caused by the non-mutagenicity of some of these compounds, by differences in toxicity between isomers. (Lantz-PTT)
W88-01899

FIGHT AGAINST INDUSTRIAL AND URBAN POLLUTION IN THE ARTOIS - PICARDIE BASIN,
Artois-Picardie Water Agency, Douai (France).
Y. Raak.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 371-379, 1987. 1 fig, 1 tab.

Descriptors: *Water quality control, *Water pollution prevention, *Fines, *Punishment-reward system, *Nonstructural alternatives, Planning, Industrial wastes, Artois-Picardie Basin, Quality control, France, Municipal wastes, Economic aspects, Food-processing wastes, Wool-washing wastes.

The Artois-Picardie Water Basin is one of the six French water basins whose limits were defined by the 1964 Law on Water. The Water Basin Agency is a public body created to fight against water pollution and to manage water resources. It collects fees from those who pollute and from those who use ground and surface waters; the collected funds are redistributed to industries and local communities that construct sewage networks and purification plants. Thanks to the financial and technical attack launched by the Agency, good results were achieved. In the industrial field, organic pol-

lutants discharged was reduced to a third with considerable success in several sectors: discharged pollution reduced by 80% in vegetable canning facilities, by 70% in paper plants, by 85% in sugar plants, and by 75% in wool-washing plants. The percentage of eliminated pollution coming from communities progressed from 15% to 35%. (Author's abstract)
W88-01931

DEVELOPMENT OF ENVIRONMENTAL ENGINEERING EDUCATION IN DEVELOPING COUNTRIES,
Qatar Univ., Doha. Dept. of Civil Engineering.
S. Ahmad.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 401-407, 1987. 13 ref.

Descriptors: *Education, *Environmental engineering, *Developing countries, Engineering, Regional development, Water management, Wastewater treatment, Environmental protection, Water pollution control.

Environmental engineering education should include appropriate curricula, courses and subject materials relevant to the needs of the society. Emphasis on environmental engineering should be laid at the undergraduate level, but to develop local capabilities both for the present and the future, it is essential to develop post-graduate education and training for young engineers and continuing education program for senior engineers. Research work should be encouraged and financed so as to develop local expertise and know-how for solving environmental engineering problems. Students should be exposed to the concept of appropriate technologies, however simple these may appear. Many of the concepts developed in advanced countries in connection with environmental protection need modification before application. These may not be directly applicable to the conditions found in the region in which many of the developing countries are located. Necessary incentives, rewards, security of job and opportunities for professional development should be provided to attract engineers to the environmental engineering profession. (Author's abstract)
W88-01934

METHODS OF LIMITING POLLUTANT WASHOUT FROM FARMING AREAS BY NONPOINT AND DRAINAGE FLOWS,
Institut Gidrodinamiki, Novosibirsk (USSR).
V. G. Magmedov.
Hydrological Sciences Journal HSJODN, Vol. 32, No. 3, 359-369, September 1987. 5 fig, 1 tab, 18 ref.

Descriptors: *Water pollution control, *Nonpoint pollution sources, *Agricultural runoff, Irrigation, Drainage water, Phosphorus, Nitrogen.

A complex of hydrogeological, hydrochemical, and biochemical investigations aimed at developing methods for the quality control of irrigation return water and agricultural nonpoint discharge was conducted from 1981 to 1985. The chemical composition of drainage flow in the zone of transient humidification in the Ukraine has been investigated; some dependencies of salts and humidity transfer rates as a function of a range of irrigation and climatic factors have been established. A new so-called 'bioengineering' type of water-protective structure based upon natural mechanisms of water purification has been developed. The bioengineering unit for water quality control, aggregating the purifying powers of microflora, macrophytes and soils, allows an improvement of 20% on average above the known purification from nitrogen compounds of natural- and waste-water achieved by bioponds, botanical plots, phytofiltering units etc., with a concurrent cutting of the treatment period by 2-3 times. The efficiency of the bioengineering structure for the reduction of the content of nitrogen, phosphorus and some compounds has been determined as a function of temperature, duration of the flow contact with biogeocenosis, water column depth and other parameters. (Lantz-PTT)
W88-01966

REPORT ABOUT EXPERIENCES IN INTERCOMPARISON STUDIES IN THE ADMINISTRATION FOR WATER ECONOMY OF RHEINLAND-PFALZ (ERFAHRUNGSBERICHT UBER RINGVERSUCHE IN DER WASSERWIRTSCHAFTSVERWALTUNG VON RHEINLAND-PFALZ),
Wasserwirschafts amt Kaiserlautern (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W88-01975

ROLE FOR WATER SUPPLY AND SANITATION IN THE CHILD SURVIVAL REVOLUTION,
North Carolina Univ. at Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 5F.
W88-01990

GERMAN TECHNICAL STANDARD FOR THE ASSESSMENT OF LAKE WATER QUALITY AND ITS APPLICATION TO HARTBEESPOORT DAM (SOUTH AFRICA),
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 2H.
W88-02091

WATER QUALITY ASPECTS OF ARTIFICIAL AQUIFER RECHARGE WITH TREATED WASTEWATER,
University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Programme.
W. A. J. Paling.
Water SA, Vol. 13, No. 2, p 95-102, April 1987. 6 fig, 16 ref.

Descriptors: *Water quality, *Artificial recharge, *Wastewater renovation, *Aquifers, *Conjunctive use, Water reuse, Literature reviews, Percolation, Nitrogen, Nitrates, Phosphates, Drought.

The use of wastewater for artificial recharge of aquifers is considered. The physical and chemical processes during percolation of treated wastewater to the saturated zone of an aquifer were studied. International experience in this field is summarized in a literature review. Column tests were conducted in order to obtain preliminary information on the loading rates of artificial aquifer recharge under local conditions. Removal of phosphates is found to occur as well as other improvements to the water. In the early stages of the column tests ammonia reduction was 100%. After a few flooding and drying cycles the ammonia concentration started to increase, resulting in a reduction of approximately 60%. A more rapid succession of shorter flooding periods together with adjusted drying periods is likely to provide continually high reduction rates. Poor removal of nitrate was noted; its cause requires further study. (Airone-PTT)
W88-02092

EVALUATION OF AN ACIDIC WASTE SITE CLEANUP EFFORT,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W88-02144

SODIUM BOROHYDRIDE REDUCES HAZARDOUS WASTE,
Morton Thiokol, Inc., Danver, MA. Ventron Div.
For primary bibliographic entry see Field 5D.
W88-02180

USE OF ATP AS A MEASURE FOR CONTROL OF MICROBIAL CONTAMINATION IN METALWORKING FLUIDS,
McNamee, Porter and Seeley, Ann Arbor, MI.
S. J. Kang, and L. B. Pugh.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 561-576, 10 fig, 1 tab, 7 ref.

Descriptors: *Water pollution control, *Water quality control, *Adenosine triphosphate, *Microbiological studies, *Metal-finishing wastes, Water analysis, Wastewater treatment, Monitoring, Hydrogen ion concentration, Toxicity, Costs.

The ATP (adenosine triphosphate) assay has been shown to be an accurate measure of microbial activity in wastewater processes, drinking water, food products, urine, and other applications. ATP is present in all living cells, and degrades rapidly following the cell's death. It reacts with the enzyme, luciferin-luciferase, to produce light which can be easily measured and quantified. The measurement of ATP can be usually made within minutes, and can be directly correlated with microbial activity. The objective of this study was to investigate the applicability and limitations of the ATP assay both for monitoring and control of microbial activity in metalworking fluids. The study was divided into three phases: a field study involving parallel monitoring to compare the ATP assay with existing monitoring methods, a laboratory verification study, and a final field study for biocide optimization. Eleven metalworking systems were selected for a parallel monitoring study at a large automobile manufacturing facility. Monitoring techniques in use at the time of the study were pH and the B-F Indicator viability test. These tests are typically performed twice per week at this facility. Concurrently performed for a six-week period were the ATP assay and the Petrifilm viability test for comparison. The ATP methodology was shown to be useful in optimizing biocide usage. Through jar testing, the effectiveness of various types and concentrations of biocides/fungicides can be determined within one hour. A savings in cost can be realized by using this procedure, since biocides to which a system is immune need no longer be dosed on a full-scale basis only to discover later that they were ineffective. As information is accumulated in using the ATP methodology both as a monitoring tool and in biocide optimization, a data base can be developed relating system conditions, biocide usage, and the length of time given types and concentrations of biocides remain effective under various conditions. In addition to greater system control, a great savings in both biocide/fungicide and metal-working fluid cost should result through optimized use of these products. (See also W88-02132) (Lantz-PTT)
W88-02189

EMERGENCY STABILIZATION AND CLEANUP OF DIOXIN SITES,
Environmental Crisis Engineers, St. Louis, MO. Ryckman's Emergency Consulting Team.
M. D. Ryckman, and F. G. Nitsch.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 577-580.

Descriptors: *Cleanup operation, *Dioxins, *Hazardous wastes, *Disposal sites, *Missouri, Times Beach, Stabilization, Case studies, Water pollution control, Agent Orange.

State-of-the-art integrated engineering investigation/remedial action programs for are described for use at dioxin contaminated sites. Site hazard assessment procedures, personnel decontamination systems, dioxin cleanup and stabilization strategies, and destruction methodologies are illustrated through review of case histories involving work at Times Beach, Missouri, an abandoned Agent Orange manufacturing facility and a dioxin contaminated truck terminal. (See also W88-02132) (Lantz-PTT)
W88-02190

ILLEGAL LIQUID INDUSTRIAL WASTE SITE CLEAN-UP AND RESTORATION,
Ontario Ministry of the Environment, Toronto (Ontario). Environmental Approvals and Project Engineering Branch.
D. C. Alleway, and I. R. Pawlowski.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA.

1985. p 649-657, 6 fig, 6 tab.

Descriptors: *Industrial wastewater, *Cleanup operations, *Waste disposal, *Liquid wastes, *Ontario, *Water quality control, Water sampling, Water pollution prevention, Trichloroethylene, Toluene, Trichloroethene, Xylene, Ethyl benzene, Acetone, Organic compounds.

Between May and October 1982, a variety of liquid and solid industrial wastes had been illegally buried on a 100 acre farm approximately 40 km northwest of Metropolitan Toronto in King Township. In October 1982, a nearby resident first reported to the Ministry of the Environment that waste haulage vehicles were entering the property. The initial investigation revealed that the presence of demolition wastes. In Ontario these were considered non-hazardous wastes. The wastes had been used to construct a laneway past the farmhouse, across the farm to a ravine area, some 600 m east of the sideroad. As a precautionary measure beginning in March 1983, water samples were collected from two creeks which drained the farm area where the waste disposal had occurred. Low concentrations of trichloroethylene (about 20-50 ppb) were discovered in March. These results prompted a further investigation of the farm and activities of the waste haulage company suspected to be responsible. Suspecting some drums were buried in the site, Ministry staff conducted preliminary geophysical surveys of the site in March and July, 1983 and anomalies were found. Between April 25 and 27, 1983, a local contractor was retained by the Ministry of the Environment to make excavations using a backhoe. Following a shutdown of the cleanup operation for financial reasons, the Ministry initiated the continuance ot the cleanup operations. It was concluded that all solid and liquid waste, contaminated soil and sources of contamination had been removed from the site and disposed of in accordance with the criteria established by the Ministry of the Environment. The three shallow piezometers 5, 6 and 7 located at the east end of the site, and the Creek, represent conditions at the discharge end of the groundwater flow system. As recommended by the consultant, groundwater monitoring will continue at these locations to ensure that the analytical data show the contaminant levels will remain below the Ministry's clean criteria. (See also W88-02132) (Lantz-PTT)
W88-02197

CONTAMINANT FIXATION PROCESS,
Environmental Protection Polymers, Inc., Hawthorne, CA.
For primary bibliographic entry see Field 5E.
W88-02200

APPROACH TO EUTROPHICATION PROBLEMS CLOSE TO AN EXPANDING METROPOLIS IN AUSTRALIA,
VBB/SWECO Consulting Group, Stockholm (Sweden).
E. Isgard.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 161-170, 5 fig, 2 tab, 5 ref.

Descriptors: *Water quality control, *Eutrophication, *Australia, *Hawkesbury River, *Wastewater treatment, Sludge, Water pollution prevention, Chemical precipitation, Chemical treatment, Ferric chloride, Denitrification, Phosphorus.

The Hawkesbury River basin in SE Australia is mainly composed of forest and agricultural land. The river provides water supply for the neighboring Sydney area and the basin - 26% of which is national park - is very popular as recreation areas for the metropolitan population. The river is affected by tidal influence from Windsor reaching more than 50 km upstream of the outfall in the Broken Bay. The freshwater flows are highly variable with annual discharges at Penrith varying between 1 and 245 cu m/sec. Of special interest is the impact of the discharge of sewage, treated to a required level, for the future population. Responsible authority for the planning is the Metropolitan Water Sewarage and Drainage Board (MWSDB). The water quality problems are foreseen mainly to be eutrophication. The available nutrient removal options are phosphorus removal via chemical precipitation with ferric chloride, and single-sludge pre-denitrification. (See also W88-02227) (Lantz-PTT)
W88-02243

WATER-COURSE MONITORING IN A SWEDISH RIVER BASIN: GROWTH, DEVELOPMENT AND FUTURE,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
G. Karlsson, and M. Lowgren.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 179-187, 6 fig, 12 ref.

Descriptors: *Water quality control, *River basins, *Water resources development, *Management planning, *Sweden, Monitoring, Regulations, Water pollution prevention, Fertilizers, Wastewater.

Pollution control, like any social policy, is a continually evolving process, altering its complexion to suit changing circumstances. Until now it has largely been a reactive activity, in the sense that it emerged as a response to unsatisfactory conditions. Thus for the most part it was predominantly an exercise in remedying damage and nuisance after it had occurred. This method of management is unlikely to deal effectively and efficiently with the emerging pollution problems. Of these, perhaps the most significant is the issue of toxic chemicals. Their numbers, quantities and latency of their effects require an anticipatory approach. The need for the development of effective early-warning systems was agreed upon at the 1972 United Nations Conference on the Human Environment held in Stockholm. However, there is still a real scientific difficulty in recognizing new substances in the environment and the buildup of known chemicals. One does not know where, when, how and what to monitor to identify hazards at an early stage. Still, environmental monitoring is an important tool for enforcing regulations about sewage discharges, use of fertilizers, etc. The development of the Swedish monitoring program during the 1980's implies that moves have been made from the efforts toward uniformity which characterized the 1970's to the introduction of local and regionally adapted programs which consider the loading activities in each respective area. Compared to international conditions, the Swedish control strategy employed is approaching the more flexible system in the UK, where control at the regional and local level may enhance the implementation of monitoring programs designed to deal with local problems as opposed to the system in the US, where statutory emission and ambient quality standards exert major influence on monitoring programs. (See also W88-02227) (Lantz-PTT)
W88-02245

GROUNDWATER QUALITY PROTECTION POLICIES FOR THE ROCKY MOUNTAIN REGION AND THE NATION.
Colorado Water Resources Research Inst., Fort Collins.
Available from the National Technical Institute Service, Springfield, VA 22161, as PB87 218210/AS, price codes: A10 in paper copy, A01 in microfiche. Transcript of Conference, Denver, Colorado, January 18, 1986. Colorado Water Resources Research Institute, Ft. Collins, Information Series No. 56, April 1986. 220 p.

Descriptors: *Groundwater quality, *Water quality control, *Water pollution effects, *Conferences, Water pollution control, Agriculture, Mining, Industrial wastes, Legislation, Public policy.

This is a transcript of the Conference on Groundwater Quality Protection Policies for the Rocky Mountain Region and the Nation held in Denver, Colorado on January 18, 1986. The conference, and five others like it in other regions of the country, were held to provide input for a groundwater protection agenda for the U.S. Congress as it begins debate on new groundwater quality protection initiatives. The conference featured roundtable discussions among officials from the sponsoring organizations, local and state officials, environmentalists, corporate representatives, farm groups and others on groundwater protection needs and current programs in the region. Also considered were federal policy options, legislation and mechanisms to implement groundwater policies through what are necessarily local and individual decisions. Topics covered a variety of groundwater contamination issues, but is specifically highlighted the implications of agricultural and mining activities on groundwater quality. (Lantz-PTT)
W88-02269

MOUNT ST. HELENS: THE AFTERMATH,
Bureau of Reclamation, Washington, DC. Office of Water Research.
D. C. Flaherty.
Available from the National Technical Institute Service, Springfield, VA 22161, as PB 87-183240, price codes: A04 in paper copy, A01 in microfiche. Washington Water Research Center, Pullman, August 1, 1983. 65 p. Project C-00217-V(1). Contract 14-34-0001-0534.

Descriptors: *Mount Saint Helens, *Environmental effects, Topography, Volcanoes, Toutle River, Spirit Lake, Cowlitz River, Ash, Conferences, Water resources, Water quality, Water supply.

Work done to date on the Mount St. Helens' projects is summarized. The massive eruption of Mount St. Helens on May 18, 1980 propelled an estimated four billion cu yds of what was once the peak's summit and northern side to the atmosphere and down its slopes. Absolute devastation resulted. To the northwest not a single living tree was found within 15 miles. The topography near and far from the volcano was rearranged by pyroclastic flows, landslides, mudflows and ashfall. A huge landslide filled the North Fork of the Toutle River, in the process damming Spirit Lake. Enormous mudflows passed down both the North and South Forks of the Toutle to the lower Cowlitz River and thence to the Columbia River. An estimated 2500 acre-ft of sediment and debris were deposited in the Cowlitz River. During the May 18 geological event, ash fell over a 100,000 sq mi area to the east. The depth of the ashfall varied from about two inches at Ritzville, Washington to almost an inch at Pullman, Washington. A conference was held in Pullman, Washington shortly after the eruption to evaluate the immediate situation and the data gathered up until then (July 8, 1980). The assembled information indicated that a wide range of possible effects from the eruption and ashfall could influence both the quality and quantity of water in the states impacted by the eruption. This information was carried back to Washington, D.C. by several members of the Pullman meeting. The U.S. Congress, recognizing both the seriousness of the threat to the water resources of the Pacific Northwest as well as the unique opportunity to investigate the effects of a volcanic eruption, appropriated two million dollars for research, to be administered through the U.S. Office of Water Research and Technology. In October, 1981, a conference with the title, 'Mt. St. Helens: Effects on Water Resources,' was held at Jantzen Beach, Portland, Oregon to present the preliminary research findings and to exchange and transfer information with such agencies as the U.S. Forest Service, Geological Survey, Army Corps of Engineers, Soil Conservation Service and the Bureau of Reclamation. State agencies were represented as were state legislators, industrial firms, and consultants as well as interested individuals. (Lantz-PTT)
W88-02272

IMPROVEMENT OF HYDROPOWER RELEASE DISSOLVED OXYGEN WITH TURBINE VENTING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
S. C. Wilhelms, M. L. Schneider, and S. E. Howington.
Available from the National Technical Information

Service, Springfield, Virginia. 22161. Technical Report E-87-3, March 1987. Final Report. 106 p, 19 fig, 4 tab, 39 ref, 4 append.

Descriptors: *Water quality control, *Dissolved oxygen, *Turbines, *Hydroelectric power, *Clarks Hill Dam, Oxygenation, Savannah River, Mathematical studies, Oxygen, Mathematical models, Computer models.

Various in-lake, in-structure, and downstream techniques may be used to enhance the dissolved oxygen concentrations of hydropower releases. In-lake and in-structure techniques appear to be the most applicable for Corps of Engineers projects because of the large discharges of most hydropower projects. Of these, the in-structure techniques, particularly turbine venting, appear very attractive considering cost and degree of improvement. Tests were conducted at the Clarks Hill Dam powerhouse to evaluate various aspects of turbine venting and thereby provide a database to develop predictive and design capabilities for turbine venting systems. Results of these tests indicated that, at most, the oxygen deficit in the penstock could be reduced by about 30%. That is, if the penstock oxygen deficit is 8.0 mg/L, then, at most, about 2.4 mg/L of oxygen could be absorbed into the release flow. Two reaeration processes that contributed to the overall oxygen transfer were observed in the tests: (a) due to the turbulence in the tailrace area and (b) due to the air bubbles (vented through the turbine) as they traveled through the draft tube. A numerical computer model of these processes was developed that included the impact of the changes in thermodynamic (pressure) state as the bubbles passed through the draft tube. By developing this 'pressure-time history,' the increased potential for oxygen transfer due to the increase in hydrostatic pressure was included in model formulation. Good agreement was obtained in comparing model predictions and oxygen uptake data from previous tests at Clarks Hill. An example of model application and economic analysis is presented. The entire process analysis and resulting numerical model are based on the data collected at Clarks Hill. Thus, application to similarly sized and designed projects should produce acceptable results. However, caution should be exercised for application to other type turbines, low-head or small projects. (Author's abstract)
W88-02280

NITROGEN AND CONTAMINANT CONTROL OF COKE PLANT EFFLUENTS IN AN UPGRADED BIOLOGICAL SYSTEM,
Canada Centre for Inland Waters, Burlington (Ontario).
T. R. Bridle, H. Melcer, W. K. Bedford, and B. E. Jank.
IN: International Conference on Application of Adsorption to Wastewater Treatment, Proceedings, February 16-19, 1981, Nashville, TN. Enviro Press, Inc., Nashville, TN. 1981. p 509-527, 5 fig, 12 tab, 15 ref.

Descriptors: *Water quality control, *Wastewater treatment, *Biological treatment, *Industrial wastewater, *Nitrogen, *Activated carbon, Nitrobacter, Hydraulic retention time, Denitrification, Gas chromatography, Mass spectrometry, Organic compounds, Calcium.

Bench scale treatability studies were conducted to evaluate the performance of the single sludge predenitrification nitrification process configuration for nitrogen and contaminant control of coke plant effluents. Complete nitrogen control was achieved provided wastewater dilution was practiced or low levels of powdered activated carbon (PAC) were added to the bioreactors. The minimum aerobic SRT required to achieve complete nitrification at 20-24 C was 22 days. Operation at high system SRT (60 d) did not facilitate nitrification of undiluted wastewater. However, at anoxic and aerobic HRT's of 0.5 - 1 and 1-3 days, respectively, complete at nitrogen control and high levels of contaminant removal were effected in undiluted wastewater by maintaining a PAC level of 500 mg/L in the reactors. The equivalent PAC feed concentrations ranged from 20 to 50 mg/L. The addition of PAC overcame Nitrobacter inhibition, which was evident in the treatment of both diluted and undiluted wastewater. The organic carbon in the wastewater was used as the energy source for denitrification and no supplemental organic carbon was required to achieve complete denitrification provided the feed FOC/TKN ratio > or = 3.5. The fate of trace organics was monitored using GC/MS methodology. Enhanced trace organic removal was effected through PAC addition. Parallel units operated with and without calcium indicated that up to 3000 mg/L of dissolved calcium in the wastewater was not detrimental to biological activity. Analysis confirmed that calcium phosphate tetrabasic was precipitated discretely in the reactors. Phosphoric acid requirements increased 10-fold when calcium was present. (See also W88-02284) (Author's abstract)
W88-02307

GROUNDWATER TREATMENT TECHNOLOGY,
DETOX, Inc., Dayton, OH.
E. K. Nyer.
Van Nostrand Reinhold Co., New York, NY. 1985. 188 p.

Descriptors: *Groundwater quality, *Water pollution treatment, *Water pollution control, *Decontamination, Wastewater treatment, Water treatment, Biological treatment, Inorganic compounds, Organic compounds, Aquifers, Nitrates, Heavy metals, Carbon adsorption.

Shown is how to apply new technologies and engineering methods to groundwater decontamination. Since groundwater cannot clean itself within a relatively short period of time - as a river or lake can - treatment must go beyond reducing or stopping waste seepage into the aquifer. Comparisons between wastewater and groundwater treatments point out the unique requirements of groundwater cleanup. This guide illustrates: (1) physical/chemical methods for organic contaminant removal - including design and application methods for pure compound removal, air stripping, and carbon adsorption; (2) biological methods for organic contamination - traditional treatment systems and specific treatment systems for groundwater treatment; (3) treatment methods for inorganic contaminants - including methods for removing heavy metals, nitrates, and totally dissolved solids; and (4) in situ methods for organic contaminants - including aquifer and unsaturated zone cleanup. For each method, the author provides all the engineering parameters necessary to design operational, safe, and effective groundwater treatment systems. Specific costs for the various treatment technologies, as well as the factors that affect those costs, are analyzed. (Lantz-PTT)
W88-02322

ISOLATION AS A RESTORATION STRATEGY FOR NUTRIENT REDUCTION IN A SMALL HYPEREUTROPHIC LAKE,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
D. G. Burden, R. F. Malone, and C. E. Mericas.
Water Research WATRAG, Vol. 21, No. 4, p 385-393, April 1987. 8 fig, 1 tab, 13 ref.

Descriptors: *Water pollution treatment, *Lake restoration, *Hypereutrophic lakes, *Limnology, *Nutrient removal, *Wastewater, *Phosphorus, Fish kills, Nutrients, Louisiana, Isolation, Water quality.

The restoration of a small hypereutrophic urban lake in Baton Rouge, Louisiana was accomplished by isolating the lake from its primary source of nutrient loading: a larger, connecting lake that was heavily contaminated by sewage. Restoration objectives were directed towards reducing phosphorus levels in the system to minimize chronic summer fish kills. Previous studies had identified a critical phosphorus level of 0.4 mg/L, below which no fish kills had been observed in this system. Above this level the kill frequency was a uniform 3.0%. Water quality data, consisting of 13 parameters, were collected over a four and one-quarter year period, representing conditions before, during and after the isolation. Evaluation of total phosphorus data indicated an approx. 90% reduction in estimated risk of summer fish kills as a result of the isolation. A general reduction in nutrient levels, as well as an increase in system stability, was also observed. Isolation of the lake proved to be a simple and economical means of attaining management objectives. (Author's abstract)
W88-02336

ADDITION OF NAOH, LIMESTONE SLURRY AND FINEGRAINED LIMESTONE TO ACIDIFIED LAKE WATER AND THE EFFECTS ON SMOLTS OF ATLANTIC SALMON (SALMO SALAR L.),
Direktoratet for Vilt og Ferskvannsfisk, Trondheim (Norway). Fish Research Div.
O. K. Skogheim, B. O. Rosseland, F. Kroglund, and G. Hagenlund.
Water Research WATRAG, Vol. 21, No. 4, p 435-443, April 1987. 6 fig, 3 tab, 26 ref.

Descriptors: *Lake restoration, *Water pollution treatment, *Water pollution effects, *Water quality, *Acid lakes, *Neutralization, *Salmon, Calcium, Aluminum, Limestone, Sublethal effects, Population exposure.

A neutralization experiment comparing NaOH, limestone slurry and finegrained limestone was performed using smolts of Atlantic salmon as testfish. Smolts were raised on chronically acid Lake Liervatn (pH = 4.9-5.4, conductivity = 55 microS/cm, Ca = 1.3 mg/L, labile Al = 40 microgram(ug)/L). As a result testfish were sublethally stressed prior to the experiment, as indicated by low levels of plasma chloride. During the experiment, smolts were held in keepnets in the middle of large plastic enclosures without sediment contact. Rapid changes in pH and Al-speciation were recorded after addition of the neutralizing agents. No mortality of fish occurred during the 3 days exposure. Plasma chloride levels in fish exposed to limestone slurry, limestone and the lowest concentration of NaOH (pH = 5.9) did not differ significantly from levels in fish from the reference group. Fish exposed to the highest concentration of NaOH (pH > 7.45), however, experienced a significant decrease in plasma chloride levels. Increased sublethal stress in treatments with NaOH was presumably caused by the presence of aluminate ions (Al(OH)4(-)) at high pH and by low concentrations of Ca. The importance of maintaining pH below 7 when using bases with monovalent cations is emphasized. Adding inorganic aluminum to the lake water induced loss of plasma chloride within 48 h at 70 ug labile Al/L at pH 5.1 and 1.2 mg Ca/L. (Author's abstract)
W88-02342

COPPER AS AN ALGICIDE IN A TROPICAL RESERVOIR,
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Botany.
P. R. Hawkins, and D. J. Griffiths.
Water Research WATRAG, Vol. 21, No. 4, p 475-480, April 1987. 4 fig, 32 ref.

Descriptors: *Copper sulfate, *Algicides, *Reservoirs, *Algae, Zooplankton, Growth, Solomon Dam.

Copper sulfate, added at the surface, was retained in the epilimnion of a stratified tropical reservoir. For 12 days after the addition, most of the copper was associated with the soluble fraction (MW > 50,000). Later the low molecular weight fraction (MW <50,000) dominated and persisted for more than 19 days. There was an immediate decline in algal density in algal density after copper addition, followed by an increase in numbers of the more copper-tolerant chlorophyte species. Zooplankton (and other aquatic fauna) were also affected by the copper treatment. Two forms of the rotifer Brachionus calyciflorus recovered first, followed by Hexarthra mira, Copepoda and Cladocera. Growth of cyanobacteria was suppressed in the short term, but any possible long term effects of copper were masked by flow induced rapid destratification which interrupted and re-set algal succession. It is concluded that copper treatment is not an effective

control of cyanobacterial growth under the seasonal flow regime to which the Solomon Dam is subjected. (Author's abstract)
W88-02347

OPTIMIZING NONPOINT SOURCE CONTROLS IN WATER QUALITY REGULATION,
Florida Univ., Gainesville. Dept. of Food and Resource Economics.
J. W. Milon.
Water Resources Bulletin WARBAQ, Vol. 23, No. 3, p 387-396, June 1987. 1 fig, 2 tab, 37 ref.

Descriptors: *Model studies, *Costs, *Stochastic process, *Water quality control, *Water pollution sources, *Effluents, *Nonpoint pollution sources, Watersheds, Agriculture, Planning, Regulations.

A stochastic programming framework is developed to evaluate the economic implications of reliability criteria and multiple effluent controls on nonpoint source pollution. An integrated watershed simulation model is used to generate probability distributions for agricultural practices. Results from the planning model indicate that reliability and multiple effluent constraints significantly increase the cost of nonpoint controls but the effects vary by control alternative. The analysis indicates that an evaluation of multiple water quality objectives can be an important planning tool for designing nonpoint source controls for innovative programs to promote cost-effective water quality regulation. (Author's abstract)
W88-02378

EMERGING STATE ROLES IN URBAN STORMWATER MANAGEMENT,
North Carolina Univ. at Chapel Hill. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 6E.
W88-02383

DATA BASES: GETTING THE MOST FOR YOUR MONEY,
Montgomery (James M.), Inc., Pasadena, CA.
For primary bibliographic entry see Field 7C.
W88-02392

DESIGN OF DUAL-PURPOSE DETENTION SYSTEMS USING DYNAMIC PROGRAMMING,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W88-02413

CHEMICAL EFFECTS OF SPRING AND SUMMER ALUM ADDITIONS TO A SMALL, NORTHWESTERN ONTARIO LAKE,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
R. C. Playle.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 2, p 207-225, June 1987. 7 fig, 4 tab, 37 ref.

Descriptors: *Lakes, *Limnology, *Acid rain, *Water pollution treaatment, *Lake restoration, Acidity, Ions, Alkalinity, Aluminum, Alum, Phosphorus, Cations.

Aluminum was added as aluminum sulfate (alum) to Lake 114, a small, shallow lake of the Experimental Lakes Area, northwestern Ontario, in spring and summer point-source additions. Aluminum and H(+) gradients were established during the additions, with high Al and low pH (about 1000 microgram(ug)/L Al, pH 4.7) near the alum sources, and background conditions (< 50 ug/L Al, pH 5.7) further from the sources. Approximately 80% of the added Al was lost from the water column in two weeks. Phosphorus concentrations remained unchanged during the additions, whereas lake alkalinity decreased and sulfate increased close to the sources. Dissolved organic carbon (DOC) concentrations decreased slightly (from 540 micromoles/L to about 500 micromoles/L) near the alum source during the summer addition. (Author's abstract)
W88-02462

REMOVAL OF METAL IONS FROM AQUEOUS SOLUTIONS BY PENICILLIUM BIOMASS: KINETIC AND UPTAKE PARAMETERS,
Tel-Aviv Univ. (Israel). Dept. of Botany.
For primary bibliographic entry see Field 5B.
W88-02472

NONLINEAR OPTIMIZATION MODELING OF COLIFORM BACTERIA,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
D. H. Burn, and E. A. McBean.
Water, Air, and Soil Pollution WAPLAC, Vol. 32, No. 1/2, p 183-200, January 1987. 7 fig, 4 tab, 10 ref.

Descriptors: *Model studies, *Planning, *Water quality, *Coliforms, *Water pollution control, *Bacteria, Water treatment, Disinfection, Decision making.

An optimization model for use in the planning stage of the water quality management process was developed. The model determined the optimal removal of coliform bacteria in accordance with an objective function which reflects the uncertainty aspects of the problem. Several management options are available through model use thereby providing a decision-maker with considerable latitude to evaluate the relative importance of the conflicting objectives of the problem. (Author's abstract)
W88-02490

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

WATER QUALITY MODELING: A REVIEW OF THE ANALYSIS OF UNCERTAINTY,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W88-01675

LIQUID DISPOSAL, INCORPORATED; A $2.2 MILLION SUPERFUND IMMEDIATE REMOVAL ACTION,
Weston (Roy F.), Inc., Northbrook, IL. SPER Div.
For primary bibliographic entry see Field 5E.
W88-01743

SITE SAFETY AT THE MIDDLETOWN ROAD REMOVAL,
Geo/Resource Consultants, Inc., Washington, DC.
For primary bibliographic entry see Field 5E.
W88-01744

CAPABILITY MAPPING FOR SANITARY LANDFILL USING COMPUTER GRAPHICS,
Wisconsin Univ.-Green Bay.
For primary bibliographic entry see Field 5E.
W88-01754

WATER AND THE MICHIGAN ECONOMY: MANAGING WATER QUALITY,
Michigan State Univ., East Lansing. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W88-01758

DEVELOPMENT OF AN EXPERT SYSTEM FOR THE ANALYSIS OF URBAN DRAINAGE USING 'SWMM' (STORM WATER MANAGEMENT MODEL),
Purdue Univ., Lafayette, IN. Water Resources Research Center.
C. Baffaut, S. Bernabdallan, D. Wood, J. Delleur, and M. Houck.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 217188/AS. Price codes: A09 in paper copy, A01 in microfiche. Technical Report No. 180, June 1987. 94 p, 3 tab, 3 fig, 30 ref, 5 append. Contract No. 140-08-0001-G1224. Project No. USGS G1224-03.

Descriptors: *SWMM model, *Urban drainage, *Stormwater management models, *Expert systems, Urban hydrology, Artificial intelligence, Model studies, Systems analysis, Watershed management, Indiana, Ross-Ade watershed, Glen Ellyn watershed.

An expert system has been built to facilitate and to automate the calibration of the runoff block of the Storm Water Management Model (SWMM). It acts as a front end to counsel the user on the choice of parameters, it interprets the result and suggests some useful changes in the value of significant parameters thus reducing the user's time and effort. The integration of new expert systems and traditional simulation models is best achieved through the use of modern expert system shells because of their ability to develop rapid prototypes and because they interface with existing and well accepted softwares such as SWMM. (Cushman-Purdue U.Water Res. Ctr.)
W88-01759

STRATEGIES FOR RIVER BASIN MANAGEMENT: ENVIRONMENTAL INTEGRATION OF LAND AND WATER IN A RIVER BASIN.
D. Reidel Publishing, Co., Dordrecht, Holland. 1985. 346 p. Edited by Jan Lundqvist, Ulrik Lohm, and Malin Falkenmark.

Descriptors: *River basins, *Management planning, *Water resources development, *River basin development, Resources management, Symposium, Economic aspects, Ecological effects, Land use, Water use.

This edition of GeoLibrary is an outcome of an international seminar: River Basin Strategy; the relevance of river basin approach for coordinated land and water conservation and management. The seminar was held at the University of Linkoping, Sweden, 4-8 June, 1984. About 50 participants from more than 20 countries and several international organizations took part in the sessions. In Chapter 1, it is argued that with increasing socio-economic development it is necessary to pay due attention to environmentally sound planning and evaluation procedures. By applying an ecosystem view on resource utilization, the potentials and limitations can be rationally assessed with regard to a sustainable utilization. In Chapter 2 the close interrelationships between water and land, or rather land use, are analyzed. The papers illustrate the paramount need for improvements in management and conservation in large parts of our world. In many developing countries, human pressure on land and water resources in combination with adverse climatological conditions, i.e. unreliable and sometimes very heavy rainfall, in sensitive surroundings have seriously threatened the environment. Various conflicts over water and their management are discussed in Chapter 3. Besides formal procedures, a number of informal tools in terms of economic sanctions and the use of non-formal institutions may be of considerable importance both for avoiding and for the handling of conflicts. Conflict management is, however, complicated by a number of circumstances. Illustrations of practical experiences from developed as well as developing countries show that political interference and well established routines in the administrative set-up may underline conflicts or hamper a rational management. In Chapter 4, solutions to the administration of resources in a river basin context are discussed. (See W88-02228 thru W88-02262) (Lantz-PTT)
W88-02227

RIVER BASIN STRATEGY FOR COORDINATED LAND AND WATER CONSERVATION: SYNTHESIS AND CONCLUSIONS,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.

J. Lundqvist, U. Lohm, and M. Falkenmark.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 5-17.

Descriptors: *River basins, *Management planning, *Land use, *Water conservation, Conservation, Erosion, Urban planning, Legal aspects, Water transfer, Environmental policy, Productivity, Administrative regulations, Decision making, Regulations.

The world suffers at present from a number of severe global problems related to the natural environment which cause a large-scale deterioration of the natural resource base for present and future generations. Some of these are: (1) land degradation in developing countries; (2) urban growth as seen in the river basin perspective; and (3) water quality degradation. Based on the discussions around these (and other) issues, and case studies presented, a number of criteria were developed for land/water integration and for legal and administrative tools, allowing such integration. Several of these criteria are: (1) environmental management should be seen as inseparably connected with land and water management; (2) the role of environmental management should be to maintain both the productivity of the primary resources and their linkages; (3) transbasin water transfers may reduce the importance of the drainage basin as a relevant terrestrial unit; (4) the established of legal and administrative tools must make sure that every decision-maker is put into a position to take into account all the benefits and all the costs generated by his/her decision; (5) rules should not be encouraged that give precedence to certain uses and users or establish rigid criteria that must be obeyed under all circumstances; and (6) when establishing river basin agencies, clear definitions should be made of the terrestrial area of jurisdiction and the functional responsibilities vis-a-vis other governmental agencies. (See also W88-02227) (Lantz-PTT)
W88-02228

ECOSYSTEM MODELLING OF A RIVER BASIN,
Economic and Social Commission for Asia and the Pacific (UN), Bangkok (Thailand).
V. R. Pantulu.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 31-40, 4 fig, 4 ref.

Descriptors: *Ecosystems, *River basins, *Model studies, *Nam Pong River, *Thailand, *Management planning, Simulation analysis, Watersheds, Reservoirs, Catchments, Irrigation, Estuaries, Water use.

An approach adopted in ecosystem modeling of the Nam Pong river basin in northeast Thailand views a river basin as a highly complex ecosystem, comprising numerous interactive and interrelated factors, including human activities. In order to assess the response of the ecosystem to resource management actions, therefore, its functional components and their linkages have to be defined. Taking the river as the axis of the natural system, six physical subsystems can be identified in a stylized tropical river system: (1) Upstream watershed system, including upland forests and agriculture; (2) The reservoir subsystem and the drawdown area, the associated lake perimeter population and its activities; (3) The downstream catchment subsystem; (4) The urban and industrial subsystem; (5) The irrigation subsystem; and (6) The estuarine and coastal zone subsystem. The most obvious and important linkages between each of the six subsystems are the physical flows of water, sedimentation, nutrients and water pollutants (chemical and biological). Since these are sequential gravity flows from upstream to downstream they create no feedback loops. In general, linkages among subsystems arise as a result of flows of five classes of attributes namely, material, population, capital, energy, and information. However, it is perhaps more convenient in terms of presentation and analysis to classify these into three classes: physical (material and energy), population, and economic flows. Furthermore, objectives and instruments of resource management have to be specified, in order to identify management options. The consecutive steps of ecosystem analysis and modelling are illustrated as exemplified by the Nam Pong river basin in which a multipurpose reservoir was constructed. The predictive simulation model developed for this river basin illustrates the ecological implications of resource management actions and serves as a decision-making tool. (See also W88-02227) (Lantz-PTT)
W88-02230

ECOSYSTEM APPROACHES TO RIVER BASIN PLANNING,
Inland Waters Directorate, Ottawa (Ontario). Water Planning and Management Branch.
P. J. Reynolds.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 41-48, 1 fig, 18 ref.

Descriptors: *Ecosystems, *River basins, *River basin development, *Management planning, *Saint Lawrence River, *Great Lakes, Decision making, Regulations, Environmental policy.

Over the past two decades there have been many versions of the 'ecosystem approach'. Much of the work has been abstract and relatively difficult to implement by decision-makers. Most of these approaches share the following characteristics: a primary focus on ecological phenomena as opposed to engineering, economic, or jurisdictional phenomena; a perception of some self-regulatory capacity on the part of an ecosystem; a recognition of the marked responsiveness of many ecological systems to natural and human activities; and a readiness to strike a pragmatic compromise between detailed reductionistic understanding and more comprehensive, holistic meaning. In the Great Lakes and St. Lawrence River Basin, workers are now trying to implement operational and institutional forms of ecosystem approach. Ten of these initiatives are assessed here, taken from all government levels, directed toward river basin, open lake, coastal, and hinterland components of the basin. This comparison illustrates the range of proposals now under consideration in the basin and identifies their common elements. These features are offered as a definition of the criteria involved in an ecosystem approach. It is suggested that flexible eclectic pragmatism may be the most productive attitude toward Great Lakes environmental problems. (See also W88-02227) (Author's abstract)
W88-02231

IMPORTANCE OF SOIL CONSERVATION IN THE CONTEXT OF RIVER BASIN REALITIES,
Government of India, New Delhi. Advisory Board on Energy.
B. B. Vohra.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 63-70, 4 ref.

Descriptors: *Management planning, *Water resources development, *India, *Land development, Water conservation, Soil conservation, Irrigation practices, Groundwater, Deforestation, Drainage, River basins.

Developing countries, faced with the twin problems of poverty and rapidly growing populations, must give the highest priority to the optimum management of their natural resources of land and water, which constitute their basic life-support systems. The management of these resources must necessarily be attempted in an integrated manner, so closely and inextricably are they inter-linked with each other. However, since the soil is an irreplaceable and nonrenewable resource and since proper soil and land management automatically results in the conservation of a great deal of water, it would be good strategy to pay special attention to this subject, particularly because it has suffered from serious neglect in the past. The problem of land management in India is truly formidable in size and scope. According to official statistics, out of a total area of 266 million hectare (mh) which have a potential for production, as many as 175 mh suffer from degradation caused for the most part by soil erosion but also by water logging and salinization. This means that, on an average, at least 2 out of every 3 ha of land in India are today not in good health. However, it is also known that at least half of the sick lands are almost completely unproductive. In other words, around one third of Indian lands are almost completely unproductive, another one-third is partially productive and it is only the remaining one-third which is in good health. It should be quite obvious, even to a superficial observer that there is no earthly chance of eradicating poverty and surviving as a self-respecting nation so long as such a state of affairs persists. The afforestation of denuded watersheds and wastelands, the provision of adequate drainage in canal-irrigated areas and the greater use of groundwater for irrigation must accordingly form an important part of all river basin development programs. (See also W88-02227) (Lantz-PTT)
W88-02233

SOME STRATEGIC PRINCIPLES FOR LONG-TERM RIVER BASIN DEVELOPMENT - THE CASE OF HAN RIVER,
Yangtze Valley Planning Office, Wuhan (China).
For primary bibliographic entry see Field 4A.
W88-02241

INTEGRATED RIVER BASIN DEVELOPMENT; THE CHALLENGES TO THE NILE BASIN COUNTRIES,
Associated Consultants, Khartoum (Sudan).
Y. A. Mageed.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 151-160, 2 fig, 7 ref.

Descriptors: *Water resources development, *River basin development, *Nile River, *Management planning, Water supply, Water use, Social aspects, Political aspects, Legal aspects, Long-term planning, Public policy, Public participation.

The patterns of development in the Nile basin were examined against the natural characteristics of the river including basin area, topographic and hydrological features and the human interferences including technical approaches, institutional and legal arrangement associated with political, and socio-economic circumstances and events that prevailed in the basin in a historical perspective. To realize an integrated approach in this basin it is extremely important to create new attitudes between the basin states to promote cooperation and harmonization in the planning and development efforts, enhance the technological capabilities and institutional reforms necessary to cope with the intricate and complex problems of integrated river basin development. The legal framework inherited from colonial times and which created a spirit of suspicion among basin states need to be viewed through consultations and cooperation between themselves. The integrated river basin development is a long term process and must be based on conditions and realities that exist in the basin rather than copy existing models in other basins. The paper concludes that the Nile basin has all the potential for integrated development for the transformation of the basin societies and their well being. Such movement should be led by the intellectuals of the basin as a front line for an effective participation of the basin people and for setting up the process in the right direction to achieve its ultimate goals. (See also W88-02227) (Author's abstract)
W88-02242

WATER-COURSE MONITORING IN A SWEDISH RIVER BASIN: GROWTH, DEVELOPMENT AND FUTURE,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
For primary bibliographic entry see Field 5G.
W88-02245

LEGAL AND ADMINISTRATIVE TOOLS FOR RIVER BASIN DEVELOPMENT,
For primary bibliographic entry see Field 6E.
W88-02246

LEGAL, ADMINISTRATIVE AND ECONOMIC TOOLS FOR CONFLICT RESOLUTION, PERSPECTIVES ON RIVER BASIN MANAGEMENT IN INDUSTRIALIZED COUNTRIES,
York Univ. (England). Dept. of Economics.
For primary bibliographic entry see Field 6E.
W88-02247

COORDINATED MANAGEMENT OF LAND AND WATER RESOURCES; REGIONALIZATION AND INSTITUTIONS,
Politechnika Warszawska (Poland).
J. Kindler.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 279-285, 6 ref.

Descriptors: *Water resources development, *Management planning, *Land resources, Resources development, Institutions, Political aspects, Regional planning.

Some basic interrelationships between land and water, are reviewed, considering the two related issues of regionalization and institutional arrangements. Based on a few examples, it is shown that administrative regionalization that almost precisely follows the watershed boundaries does not necessarily lead to better planning, more effective management or coordinated use of land and water resources. Even the best planning schemes often fail if there are no adequate institutional arrangements governing land and water use. The difficulties in interaction among many entities and rules concerned are examined. To achieve coordinated management of land and water resources, the river basins, which are coherent hydrological units relevant to water control, should be seen in the broader societal contexts. (See also LW88-02227) (Author's abstract)
W88-02254

NONLINEAR PROGRAMMING METHODS IN RESERVOIR SYSTEM MANAGEMENT,
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 2H.
W88-02273

STOCHASTIC DYNAMIC PROGRAMMING BASED APPROACH TO THE OPERATION OF A MULTI-RESERVOIR SYSTEM,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W88-02376

HYDROLOGIC SIMULATION OF THE BRANDYWINE BASIN,
National Chunghsing Univ., Taichung (Taiwan). Graduate Inst. of Urban Planning.
For primary bibliographic entry see Field 2E.
W88-02380

OPTIMAL DAILY OPERATION OF SURFACE-WATER SYSTEMS,
Lower Colorado River Authority, Austin, TX. Water Policy and Programs Div.
For primary bibliographic entry see Field 6D.
W88-02412

OPTIMAL CANAL LOCATION USING ENVIRONMENTAL MAPPING,
Lower Colorado River Authority, Austin, TX. Water Policy and Programs Div.
Q. W. Martin.
Journal of Water Resources Planning and Management JWRMD5, Vol. 113, No. 4, p 512-521, July 1987. 6 fig, 2 tab, 15 ref.

Descriptors: *Model studies, *Pipelines, *Water conveyance, *Engineering, *Design standards, Transportation, Channels, Costs, Networks, Algorithms.

Proper planning of water conveyance systems requires consideration of both environmental and engineering factors in the earliest phases of project evaluation. A method is presented for using environmental data directly in the preliminary selection of a pipeline or canal route. The environmental factors considered include land use; mineral, water, and ecological resources; and transportation networks. The method requires the study area to be divided by a rectangular grid into subareas or cells. A cumulative disturbance cost is calculated for each cell according to the features in that cell and subjective disturbance penalties. The possible routes are represented by a directed network with the length of each route segment corresponding to the average of the disturbance costs for the connected cells. The minimum-impact route is determined by solving for the shortest path in the network using a mathematical algorithm. The method is demonstrated for a potential canal in southern Texas. (Author's abstract)
W88-02416

OPTIMAL AQUEDUCT CAPACITY AND DISTRIBUTION POLICY: CONTINUOUS APPROACH,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 5F.
W88-02418

OPTIMAL AQUEDUCT CAPACITY AND DISTRIBUTION POLICY: DISCRETE APPROACH,
California Univ., Davis. Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 5F.
W88-02419

RELIABILITY INDICES FOR WATER SUPPLY SYSTEMS,
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W88-02420

6B. Evaluation Process

MONITORING AN IMPLEMENTED REMEDIAL ACTION,
Conestoga-Rovers and Associates, Waterloo (Ontario).
For primary bibliographic entry see Field 5E.
W88-01745

SOCIO-TECHNOLOGICAL ASPECTS OF AUTOMATION IN PUBLIC WORKS ACTIVITIES,
Associate Quad Consultants, Visalia, CA.
W. F. Garber.
Water Science and Technology WSTED4, Vol. 19, No. 3/4, p 633-643, 1987. 1 fig, 1 tab, 4 ref.

Descriptors: *Social adjustment, *Automation, *Social aspects, *Training, *Education, Social change, Social impact, Social needs, Technology, Questionnaires, Employment.

The history of human society is replete with examples of advances in technology overrunning the ability of societal organizations to efficiently handle the resulting massive societal dislocations. The social impacts of the Industrial Revolution of the 18th and 19th Centuries illustrate how profound such effects can be. The automation-computer-robotics revolution now underway also has the potential for serious societal changes. In this regard public works activities are subject to increasing amounts of automation with impacts upon the current and net total employment and training needs. To evaluate the present status of automation in the USA, questionnaires were sent to public works authorities in 110 cities or agencies. The current degree of automation, the impact upon employment and the skills now needed by public works employers were queried. It was found that in most cases automation was just starting; but that as complete automation as was possible was inevitable given the increasing complexity of the tasks, the demands of the public, and the long term prospects for public works funding. In many cases the candidates now in the work force were not properly trained for automation needs. Retraining and changes in the educational system appeared necessary if the employees needed were to be continuously available. Public works management as well as several labor organizations appeared to be aware of this need and were organizing to handle the training problem and the changes in employment qualifications now necessary. It appeared to be a consensus that the larger societal effects of automation should be handled by society as a whole. (Author's abstract)
W88-01957

DECISION-ANALYTIC STUDY OF THE JOINT VALUE OF SEASONAL PRECIPITATION AND TEMPERATURE FORECASTS IN A CHOICE-OF-CROP PROBLEM,
Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W88-02004

RIVER BASIN DEVELOPMENT STRATEGIES IN THE TISZA VALLEY,
United Nations Environment Programme, Nairobi (Kenya).
L. David.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 19-29, 4 fig, 11 ref.

Descriptors: *River basins, *Tisza River, *Water resources development, *Hungary, *River basin development, Land use, Water use, Water demand, Environmental policy.

An overview of the experiences and perspectives of the river basin development process and related strategies in the valley of the Tisza River, Hungary, a main tributary of the Danube is presented, covering the period from the 19th to 21st century. Some characters of the region are described and the river basin development and its future perspectives are analyzed. It is pointed out that there is a very strong connection between the application of the basinwide strategy and the stage of river basin development. During the natural phase of development there is no need to apply the basinwide strategy. But on higher levels of the development the complexity of water and land resources management makes it necessary to apply the basinwide strategy for planning, decision making and implementation of water projects. The environmentally sound management of land and water resources needs also a basinwide river basin strategy. The multi-purpose character of the river basin strategy is also emphasized. Finally, a number of recommendations including environmental considerations are summarized. These include: (1) The river basin strategies should be analyzed in connection with the river basin development process; (2) The interactions between the river basin strategies and the growing complexity of water management during the river basin development process need to be harmonized over a long-term basis by considering the projects as an integrated element of the water management system of the basin; (3) The evaluation and the planning of river basin strategies need the application of the multicriteria decision-analysis methods, including the environmental impact and management analysis as an integrated element of the decision-making process; (4) For medium and large river basins there is often a shortage of capital resources; (5) Considering that most of the river basin strategies change the natural and social environment to a certain extent, the main objective of any water project should be to develop a new equilibrium between the project and its environment by the harmonization of the original environmental conditions and the project impacts. To achieve this goal, the development of environmental monitoring system should be an integrated part of the river basin strategy and it should be initiated

from the planning phase. (See also W88-02227) (Lantz-PTT)
W88-02229

METHODOLOGY FOR MONITORING AND EVALUATION OF INTEGRATED LAND AND WATER DEVELOPMENT,
Biswas and Associates, Oxford (England).
A. K. Biswas.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 49-61, 3 fig, 1 tab, 13 ref.

Descriptors: *Monitoring, *Management planning, *Water resources development, *Land development, Resources management, Land use, Evaluations, Design standards, Construction, Maintenance, Social aspects, Economic aspects, Agriculture.

In spite of an urgent need to consider land and water development in combination, fragmentation in education and training and existing institutional structures form important constraints. Intense past disappointments with water projects in many countries have now created a new readiness to persuade planners and decision makers to consider an integrated approach to land, water and other related resources in river basin development. The author proposes that with the massive investments in water development projects in developing countries, systematic monitoring and evaluation should become an integrated part of the management process. The information produced has to be timely, cost-effective, relevant and correct, and free from professional biases. Monitoring and evaluation have to comprise both planning, design and construction; operation and maintenance; agricultural production; and achievement of socio-economic objectives. (See also W88-02227) (Author's abstract)
W88-02232

WATER RESOURCES CONFLICTS IN INTEGRATED RIVER BASIN DEVELOPMENT: THE CASE OF KAVLINGE RIVER,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
For primary bibliographic entry see Field 6D.
W88-02251

MAKING AND THE BREAKING OF AGREEMENT ON THE GANGES,
Open Univ., Milton Keynes (England).
For primary bibliographic entry see Field 6E.
W88-02252

MAHAWELI STRATEGY OF SRI LANKA - GREAT EXPECTATION OF A SMALL NATION,
Sri Lanka Univ., Peradeniya. Dept. of Geography.
C. M. M. Bandara.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 265-277, 3 fig, 4 tab, 13 ref.

Descriptors: *Mahaweli River, *Sri Lanka, *River basin development, Evaluation, Project planning, Water resources development, Water use, Conflicting use, Water supply, Agriculture.

Sri Lanka, a small nation reputed for its ancient hydraulic civilization', is at present locked in a gigantic struggle to develop the resources of her mightiest river system - The Mahaweli. The Mahaweli Project is not merely another river development program for the Government and people of Sri Lanka. In terms of the extent of land involved, the amount of financial and other resources invested, and the number of people directly affected or shifted, it pervades almost all aspects of the economy and life of the people of the Island. The visionaries of this massive project expected major achievements in the spheres of irrigated agriculture, hydropower production, employment generation and population redistribution. The paper summarizes the salient characteristics of the Mahaweli Project, reviews its progress and discusses some of the challenges it has faced. (See also W88-02227) (Author's abstract)
W88-02253

RIVER BASIN CONCEPT AS SEEN FROM A MANAGEMENT PERSPECTIVE IN USA,
Colorado State Univ., Fort Collins. Dept. of Political Science.
N. Wengert.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 299-305, 19 ref.

Descriptors: *River basin development, *Management planning, *Regional planning, *Administrative agencies, Evaluation, Economic aspects, Social aspects, River systems, Water management, Water resources development.

In the USA, interest in river basins as units for water planning began in the late 19th century as technological progress in engineering provided data for such broader approaches. The emphasis on integrated, comprehensive river basin planning peaked in the 1930s and 1940s as epitomized by the Tennessee Valley Authority experience and New Deal emphasis on rational decision making. Well into the 1950s efforts to intertwine the water concepts of river basin development with regional economic and social planning continued to receive support. But for various reasons in the 1960s till today river basin development and regional planning have pulled part, river basin management being limited largely to hydrological aspects of river systems engineering. Regional planning and development, in turn, has ceased to focus on the river basin, becoming primarily concerned with interrelated urban socio-economic and political factors and forces with some attention to environmental values and constraints. Thus regions have become foci for urban socio-economic and political analyses, and river basins continue as significant hydrological planning units for efficient control of water resources. (Author's abstract)
W88-02257

RELEVANCE OF RIVER BASIN APPROACH FOR COORDINATED LAND AND WATER CONSERVATION AND MANAGEMENT,
Hydroconsult International, New Delhi (India).
For primary bibliographic entry see Field 6E.
W88-02259

METHODOLOGIES FOR WATER RESOURCES POLICY ANALYSIS IN RIVER BASINS,
North Atlantic Treaty Organization, Brussels (Belgium).
L. V. Cunha.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 329-335, 1 fig.

Descriptors: *Water resources development, *River basin development, *Policy making, *Management planning, Model studies, Economic aspects, Administrative agencies, Conflicting use, Ecological effects.

The special nature of water resources problems determines the specification of adequate technical, economic and institutional measures. The implementation of adequate sets of these measures constitutes water resources strategies. Consideration of coherent combinations of these strategies constitutes water resources policies. The role of models in the definition of these policies is described, with particularly emphasis on the development and application of policy oriented models to problems involving conflicts in water resources management in river basins. A series of linked strategy/impact-prediction models for evaluating alternative management policies, is presented. (See also W88-02227) (Author's abstract)
W88-02261

LONG-RUN FORECASTING OF REGIONAL ECONOMIC ACTIVITY FOR USE IN WATER RESOURCE PROJECT EVALUATIONS,
Massachusetts Univ., Amherst. School of Management.
For primary bibliographic entry see Field 6D.
W88-02277

ECONOMIC ANALYSIS FOR FISHERIES MANAGEMENT PLANS.
For primary bibliographic entry see Field 8I.
W88-02324

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

SEDIMENTATION AND THE ECONOMICS OF SELECTING AN OPTIMUM RESERVOIR SIZE,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 2J.
W88-01676

BALANCING PUBLIC TRUST RESOURCES OF MONO LAKE AND LOS ANGELES' WATER RIGHT: AN ECONOMIC APPROACH,
California Univ., Davis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6E.
W88-01677

DELAWARE RIVER BASIN: WATER PRICING AND FINANCING ISSUES,
Centre for Development Research, Hyderabad (India).
P. K. Rao.
Resource Management and Optimization RMOPDH, Vol. 4, No. 2, p 199-214, February 1987. 1 fig, 4 tab, 9 ref.

Descriptors: *Delaware River Basin, *Water rates, *Water costs, *Financing, Economic aspects, Water resources, Water use, Fees, User charges.

The Delaware River Basin Compact deals with several states. Problems of financing and water pricing assume greater and greater importance with the passage of time. Practices governing financial resources and suggestions for potential reform in water pricing are discussed: (1) In the interests of optimal water resource use and development, the system of levying water charges in the Delaware River Basin area needs to undergo several reforms in terms of widening the base of user fees as well as revising water rates; (2) Conjunctive use of ground and surface waters would be effected if there are not only restrictions on the quantity of groundwater withdrawal but also charges for groundwater use; (3) Out of the estimated total annual consumption of 2,235 billion gallons in the Basin, only 681 billion gallons of water withdrawal is subject to water charges; of this, only 14 billion gallons is charged as 'consumptive use', whereas the remaining 667 billion gallons are charged at one-hundredth of the rate of consumptive use. Thus, the effective quantity of water priced at consumptive use rate is less than 10% of the total quantity used in the year; (4) The water pricing system should be based on a classification of water users with reference to quantity and quality of water reuse possibilities; and (5) An integrated pricing system which realizes not only the costs of resource development but also of preserving water quality needs to be evolved and operationalized. (Lantz-PTT)
W88-01867

TOXIC POLLUTANT REMOVALS AND REMOVAL CREDITS AT A MAJOR POTW,
Los Angeles County Sanitation Districts, Whittier, CA.
For primary bibliographic entry see Field 5D.
W88-02196

EQUITY ISSUES IN THE IMPLEMENTATION OF RIVER BASIN PLANNING,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
I. C. Goulter.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 287-292, 15 ref.

Descriptors: *Equitable apportionment, *River basin development, *Management planning, Costs, Cost-benefit analysis, Water use, Legal aspects, Taxes, Subsidiaries, Economic aspects.

River basins planning is concerned with the development and management of the water resource in the basin. As with any planning process, the ease of implementation of the chosen strategy is extremely important in the success of the plan. One of the issues that has a significant effect on the case of implementation is equity in the way in which benefits and/or costs are distributed among the water resource users. The unique nature of the river basin, however, makes it very difficult to develop 'equitable' strategies. In many cases there is very little reciprocity in the way in which benefits or costs can be allocated among upstream and downstream users. In situations where such reciprocity does exist, uniform treatment of the resource users appears most suitable for the development of equitable solutions. In those cases where such reciprocity is not present equity can only be achieved through governmental intervention in the form of taxes and subsidies. (See also W88-02227) (Author's abstract)
W88-02255

REFORM IN COSTING AND PRICING WATER,
West Virginia Univ., Morgantown. Coll. of Business and Economics.
P. C. Mann.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 3, p 43-45, March 1987. 4 ref.

Descriptors: *Cost analysis, *Pricing, *Economic aspects, *Utilities, Prices, Income, Planning.

Pricing is the primary mechanism by which water utilities recover costs. However, costing and rate design practices in the water industry lag behind practices in other public utility sectors. Water rate innovations are reviewed with the emphasis on the integration of marginal cost and traditional average cost pricing. Pricing and costing developments in other public utility sectors are discussed in relation to their applicability to water utilities. There are differences between average cost and marginal cost pricing, although these differences are overstated and vary with specific cases. Moreover, there are differences among the various fully distributed or fully allocated cost approaches used as the basis for average cost pricing, and among the various marginal or incremental cost estimation methods used as the basis for marginal cost pricing. It is concluded that the selection of costing methods and pricing forms involves numerous judgments, and that the selection of costing and pricing methods has substantial equity effects for customers. (Author's abstract)
W88-02314

ECONOMIC ANALYSIS FOR FISHERIES MANAGEMENT PLANS.
For primary bibliographic entry see Field 8I.
W88-02324

USING PEAKING FACTORS TO UPDATE WATER RATES,
CH2M, Inc., Portland, OR.
D. S. Hasson, and D. G. Ovard.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 6, p 46-51, June 1987. 1 fig, 3 tab.

Descriptors: *Water rates, *Water pricing, *Water use, Planning, Costs, Monitoring.

Activities that lower water utility costs without adversely affecting service should be pursued by water utility management. One such activity is updating peaking factors as part of water-rate updating. The cost of monitoring large retail or wholesale users during peak periods is not large, especially given the likely benefits. If customers are given proper information about how rates are computed, peaking costs to the utility can be saved, tending to offset the costs of monitoring the large users. The result is lower cost of service to users, which means lower rates. Also, service will often be improved because supply problems during peak periods will be eliminated or reduced. Water utilities have an opportunity to use rate structures that provide water at a lower cost to customers and at the same time maintain service at levels that are as good or better than under outmoded ratemaking methods. The Salt Lake County Water Conservancy District experience serves as an example of an improvement in water utility management that benefits both the utility and its users. (Alexander-PTT)
W88-02391

EFFECT OF CELL THICKNESS AND FLOW VELOCITY ON WATER COST IN DESALINATION BY ELECTRODIALYSIS,
GKSS - Forschungszentrum Geesthacht G.m.b.H., Hamburg (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W88-02435

6D. Water Demand

BALANCING PUBLIC TRUST RESOURCES OF MONO LAKE AND LOS ANGELES' WATER RIGHT: AN ECONOMIC APPROACH,
California Univ., Davis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6E.
W88-01677

SIMULATION MODEL OF COMPETITION FOR WATER RESOURCES AMONG INDUSTRIES IN A RIVER BASIN,
Washington Univ., Seattle. Dept. of Geography.
T. D. Georgianna.
Resource Management and Optimization RMOPDH, Vol. 4, No. 1, p 79-96, August 1986. 5 fig, 11 ref. NSF Grant No. NSF SES 82 - 08 - 305.

Descriptors: *Simulation analysis, *Water use, *Competing use, *Yellowstone River basin, *Montana, Available water, Management planning, Water resources, Water allocation, Water policy, Agriculture, Industrial water, Electric power production.

A set of simulated water allocation and pollution treatment policy decisions for a river basin were developed. The region investigated is the Yellowstone River Basin in Montana. A nonlinear, constrained optimization model is used to simulate policy alternatives. Within the basin, three industries compete for the available resources. The optimal allocations of water resources under different policies are determined. Next, the competitive position of agriculture for water relative to the other industries is examined for each set of policies. From an allocation perspective, it is interesting to note that there is a tendency for different resources to act as the binding constraint in different subbasins. It was found that agriculture competes well for water under a variety of conditions: in low-flow situations, in situations where pollution levels were the binding constraints, and in situations when labor also was in short supply agriculture did well due to its high marginal productivity. The institutional decision rule for the protection of agriculture had less impact than anticipated. This is a result of the fact that under several conditions agriculture does well with respect to its water allocations and is not in need of protection. The one set off conditions in which agriculture does not fare well is when water supply is short enough and the other resource constraints were nonbinding, so that manufacturing of energy can preempt water allocations with none left for agriculture. This means that there is a middle range where agriculture does not compete well. At the low end of water supply it does compete well, and at the high end there is no need for competition. (Lantz-PTT)
W88-01866

INCREASING WATER SUPPLIES IN THE IBERIAN PENINSULA,
S. Higham.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 7, p 84-88, July 1987. 1 fig.

Descriptors: *Water supply development, *Iberian Peninsula, *Spain, *Regulations, Legislation, Water demand, Water supply, Public policy, Competing use.

Wet and contrasting arid regions characterize the Iberian Peninsula, presenting challenges to water planners. Recently, the government of Spain promulgated laws, similar to those in the United Kingdom, that created river basin water authorities. Now, instead of most of the water resources of the country being under the control of large landowners, the resources have been put in the public domain. In addition, many new impoundment projects are under construction or have recently begun operation. These actions are expected to alleviate the difficulties in meeting growing water demands for urban areas as well as for irrigation of farmlands and production of hydropower. (Author's abstract)
W88-01892

REGIONAL ECONOMIC GROWTH FROM IRRIGATION DEVELOPMENT: EVIDENCE FROM NORTHERN HIGH-PLAINS OGALLALA GROUNDWATER RESOURCE,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Natural Resource Economics.
R. Mann, E. Sparling, and R. A. Young.
Water Resources Research WRERAQ, Vol. 23, No. 9, p 1711-1716, September 1987. 4 tab, 17 ref.

Descriptors: *Groundwater irrigation, *Irrigation effects, *Groundwater management, *Economic aspects, *Economic growth, Mathematical equations, Mathematical studies, Ogallala Aquifer, Aquifers, Irrigation water, Model studies, Mathematical models, Economic development, Employment.

The impact of irrigated agriculture on regional economies is a subject of continuing interest and debate. A cross-sectional analysis of 1978-1980 U.S. Census data for 104 counties in the northern High Plains is formulated. A recursive system of equations is estimated and used to derive multipliers of irrigated acreage on employment. Effects of irrigation on local employment are statistically very significant but not substantively large in the context of a developed economy. (Author's abstract)
W88-01911

SEEKING A NEW BALANCE IN THE DETERIORATING UPPER CITARUM BASIN,
West Java Provincial Planning Office, Bappeda (Indonesia).
For primary bibliographic entry see Field 6F.
W88-02234

ENVIRONMENTAL CONFLICTS: STRUCTURE AND MANAGEMENT,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
K. Bateld.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 209-218, 11 ref.

Descriptors: *Water demand, *Competing use, *Water management, Environmental effects, Political aspects, Social aspects, Water quality, Water pollution prevention, Water conservation.

Biological, material and psychological claims on natural resources imply human interventions in the natural systems. The expanding demands may create complex and severe conflicts. This paper deals with competition of water resources within political and social systems. Incompatibility of interests, goals, principles or norms of the parties involved are discussed. Within sectors such as agriculture, industry, fishing, energy, nature conservation and recreation different and sometimes irreconcilable claims on water, with different types of conflicts arising as a result: (1) Quality conflicts - far reaching claims on water quality as opposed to recipient claims. When one activity makes water unfit for use in, or causes damage to, another activity; (2) Preservation conflicts - claims for intervention in the water system as opposed to claims on undisturbed nature; (3) Quantity conflicts - when one use makes difficult/prevents another use, i.e. urban water use makes difficult/prevents another use, i.e. urban water supply as opposed to irrigation; and (4) Mixed quality/quantity conflicts. A major part of environmental dispute management occurs within legal institutions. It is argued, however, that environmental protection measures as well as conflicts in that connection through unconventional methods, may be highly rational and efficient. (See also W88-02227) (Lantz-PTT)
W88-02248

PROBLEMS OF WATER REALLOCATION IN THE COLORADO - AMERICA'S MOST FULLY UTILIZED RIVER,
Utah Agricultural Experiment Station, Logan. International Irrigation Center.
G. V. Skogerboe.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 219-227, 1 fig.

Descriptors: *River basin development, *Water allocation, *Colorado River, *Water use, *Water management, *Legal aspects, Reservoirs, Salinity, Water transport, Water rights, Water supply.

The basin development of the Colorado river started 2000 years ago and accelerated rapidly in the late 1800's. In 1922, the river flow was appropriated between upper and lower basin, based on estimated virgin flow at the dividing point at Lee Ferry. Today the river waters are highly controlled with major reservoir facilities. The paper treats the constraints of increasing downstream salinity and vast reallocation problems in the basin caused by energy development and growing domestic water needs of competing urban regions. With completion of the Central Arizona Project, the lower basin will be fully utilizing their entitlement, and further development may enforce a conversion from irrigation to domestic water supplies. In the upper basin there are still serious questions about their full entitlement, due to varying estimates of the Lee Ferry flow, and thus about the need for future water transfers from the irrigation to water supply of energy complexes. Many questions also remain unsolved regarding Indian water rights. (See also W88-02227) (Author's abstract)
W88-02249

CONFLICT BETWEEN FLOOD AND DROUGHT PREPAREDNESS IN THE COLORADO RIVER BASIN,
California Univ., Los Angeles. School of Engineering and Applied Science.
J. A. Dracup, S. L. Rhodes, and D. Ely.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 229-244, 5 fig, 4 tab, 23 ref.

Descriptors: *Flood-control storage, *Drought, *Water management, *Colorado River, *River basin development, Conflicting use, Water use, Water supply, Legal aspects, Water demand.

The Colorado River dominates water resource development in the seven states of the southwestern US. It also is one of the most carefully managed river systems in the world. The basin has been arbitrarily divided by the Colorado River Compact into the Upper Colorado Basin and the Lower Colorado Basin for purposes of interstate administration. A wide range of climate occurs throughout the basin because of differences in altitude, latitude, and topographic features. Current and projected scenarios of management use are reviewed. The combined legal, institutional, hydrologic and water demand constraints, and how they are managed under circumstances of increasingly competitive uses are examined. As a case study, the current analysis examines the 1983 spring and summer flooding in the Lower Basin and whether the US Bureau of Reclamation adequately managed the heavy spring runoff from the Upper Basin. This analysis stresses that the reasons for the flooding go beyond the climatic events of the year and the Bureau of Reclamation's response to them. Rather, the flooding was the result of the convergence of three factors: (1) the 17-year period of filling Lake Powell behind Glen Canyon Dam ended and the system of water storage reservoirs on the river basin considered full; (2) during the filling period, physical encroachment into the Lower Basin flood plain accelerated; (3) the streamflow forecast procedures were not suitable for the extreme climate variability of the Colorado River basin, as exhibited in 1983. (See also W88-02227) (Author's abstract)
W88-02250

WATER RESOURCES CONFLICTS IN INTEGRATED RIVER BASIN DEVELOPMENT: THE CASE OF KAVLINGE RIVER,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
R. Castensson.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 245-254, 5 fig, 1 tab, 10 ref.

Descriptors: *Water resources development, *Conflicting use, *River basin development, *Kavlinge River, Water management, Evaluations, Economic aspects, Social aspects, Water supply, Water demand, Ecological effects.

The river basin concept and the development strategies of the Kavlinge River basin, Sweden, are analyzed. The analysis indicates that the chosen development strategies are heavily dependent on socio-economic processes as changes in production conditions, technological renewal, legal priority, political and economic superiority. The strongest development factor is the urban growth and consequently the rising demand on water. Isolated single-purpose water development schemes have expanded to basinwide and multi-purpose water management problems. Specific local water demand conflicts have expanded to an interbasin level. Lack of adaptation in water management rules caused unforeseen ecological damages and suboptimal allocation of water resources. (See also W88-02227) (Author's abstract)
W88-02251

LONG-RUN FORECASTING OF REGIONAL ECONOMIC ACTIVITY FOR USE IN WATER RESOURCE PROJECT EVALUATIONS,
Massachusetts Univ., Amherst. School of Management.
S. P. Coelen.
Available from the National Technical Institue Service, Springfield, VA 22161, as PB87 201059, price codes: A04 in paper copy, A01 in microfiche. Final Technical Completion Report, July 1983. 58 p, 2 fig, 2 tab, 12 ref, 3 append. OWRT Grant No. 14-34-0001-9093, Project No. B-114-PA(1).

Descriptors: *Forecasting, *Water demand, Long-term aspects, Water resources, Evaluation, Population density, Water supply, Mathematical studies, Management planning, Water management.

Research carried out on this project has evaluated forecasting as applied to water resource programs. The research has highlighted population more than other variables because it so significantly and directly affects water resource needs. A summary evaluation is made of Census population estimates which are historical, intercensal forecasts. Their importance is that they guide forecasts of population into future time periods and inaccuracies in them are a source of error in future forecasts. A summary evaluation is made of the Bureau of Economic Analysis 1975 OBERS projections, using the principles of Theil error decomposition. A review of the literature is made to determine the best means of short and long term projections, making use of differentials which short and long distance migration make in this process. (Author's abstract)
W88-02277

OPTIMAL MANAGEMENT OF A REGIONAL AQUIFER IN EASTERN SAUDI ARABIA,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Earth Sciences.
For primary bibliographic entry see Field 4B.
W88-02381

USING CROP YIELD AND EVAPOTRANSPIRATION RELATIONS FOR REGIONAL WATER REQUIREMENT ESTIMATION,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2D.
W88-02382

OPTIMAL DAILY OPERATION OF SURFACE-WATER SYSTEMS,
Lower Colorado River Authority, Austin, TX. Water Policy and Programs Div.
Q. W. Martin.
Journal of Water Resources Planning and Management JWRMD5, Vol. 113, No. 4, p 453-470, July 1987. 3 fig, 33 ref.

Descriptors: *Model studies, *Reservoirs, *Decision making, *Operating policies, *Water management, *Reservoir operation, *Linear programming, Hydroelectric power, Flood control, Flow, Algorithms, Computers.

The managers of large-scale, surface-water reservoir and delivery systems are required on a daily basis to make complex operating decisions. To assist in the decision process, a computational methodology is presented for determining the optimal operation of a general surface-water resources system of water storage and conveyance facilities. The system is assumed to be operated for hydroelectric power generation, water supply, flood control, and low flow augmentation. The daily operation of such a system is represented as a deterministic, nonlinear optimization problem, with the decision variables being the average daily reservoir releases, water diversions, and pipeline and canal flows. Successive linear programming (SLP) is used to iteratively change the daily reservoir releases to improve system performance. The SLP algorithm converges to an operational policy satisfying the necessary conditions for optimality. The algorithm, incorporated into the MONITOR-1 computer program, is applied to the Lower Rio Grande System in Texas, and the results reviewed. (Author's abstract)
W88-02412

6E. Water Law and Institutions

DEVELOPMENT OF THE DUTCH POLICY CONCERNING DREDGED MATERIAL DISPOSAL,
Ministry of Transport and Public Works, The Hague (Netherlands).
D. J. Van den Bos.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 138-141.

Descriptors: *Regulations, *Policy, *Waste disposal, *Dredging, *Rotterdam, *Netherlands, Sediments, Policy development, Standards.

In the Rotterdam Harbor region yearly about 23 million cu m of sediment is dredged. About 13 million cu m is mainly of marine origin, and only

slightly contaminated. This material has always been disposed of at sea and will be for some time. The other 10 million cu m is mainly brought down by the river. Until the beginning of the 1970s this material was used for landfill, the artificial and selective continuation of the accretion of land in the Rhine and Meuse delta. Early in the 1970s, aware of the contamination of this material and the resulting effects, landfill became less and less acceptable. From 1975 many technical and environmental assessment studies have taken place, as well as a policy analysis. Sediments are classified into four groups (1 through 4) depending on the degree of contamination. Class 1 and part of class 2 sediments (the least contaminated continue to be disposed at sea. Moderately contaminated sediments are disposed on land or in pits. Class 4 sediments (the most heavily contaminated) are disposed in special depots designed to isolate the contamination. (See also W88-01522) (Lantz-PTT)
W88-01538

ENVIRONMENTAL LAW HANDBOOK,
For primary bibliographic entry see Field 5G.
W88-01654

BALANCING PUBLIC TRUST RESOURCES OF MONO LAKE AND LOS ANGELES' WATER RIGHT: AN ECONOMIC APPROACH,
California Univ., Davis. Dept. of Agricultural Economics.
J. B. Loomis.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1449-1456, August 1987. 1 fig, 1 tab, 28 ref, append.

Descriptors: *Evaluation, *Value, *Economic aspects, *Contingent Valuation Method, *Water rights, Public trust value, Water management, Legal aspects, Mathematical equations, Mono Lake, Los Angeles, California, Model studies, Costs, Comparison studies, Lakes, Lake level, Water level.

The Contingent Valuation Method (CVM) is used to quantify the Public Trust Values of Mono Lake at alternative lake levels. The dichotomous choice approach to contingent valuation is employed using a logit model. The economic benefits to California residents of preserving Mono Lake is estimated to be 1.5 billion dollars. Purchase of replacement water and power would cost 26.2 million annually. On efficiency grounds, reallocation of water for maintenance of Public Trust values at Mono Lake is warranted. The CVM appears to be a useful methodology to evaluate the balancing and feasibility tests of the expanded Public Trust doctrine suggested by the California Supreme Court. (Author's abstract)
W88-01677

HEIBERG LEADS CORPS INTO NEW ERA,
P. Hoffmann.
Engineering News Record ENREAY, Vol. 218, No. 17, p 24-26, April 23, 1987.

Descriptors: *Cost sharing, *Management Planning, Navigable waters, Waterways, Flood control, Harbors, Water supply, Hydroelectric power, Recreation.

The 1986 Omnibus Water Resources Development Act, the first major water project legislation in 16 years, is a hunting license for the administration, Congress and local cost-sharing entities to get projects moving ahead. The new law has brought major changes in project guidelines and cost-sharing arrangements. Top priority will be given to navigation and flood control projects while water supply, hydropower and recreation receive less attention. The Act was passed just as the Corps was facing manpower cutbacks; the new cost sharing means that the Corps will have to emphasize efficient planning and engineering design since local sponsors will be paying a larger share of total costs. (McFarlane-PTT)
W88-01801

ENVIRONMENTAL POLICY IN POST-MAO CHINA,
L. Ross.
Environment ENTVAR, Vol. 29, No. 4, p 12-17, 34-39, May 1987. 3 tab, 40 ref.

Descriptors: *China, *Legislation, *Public policy, *Environmental protection, *Political aspects, *Prices, Profit, Economic development, Economic aspects, Industrial wastes, Regulations.

Following the death of Mao Zedong in 1976 and a brief political interregnum that lasted until late 1978, dramatic changes have taken place in the People's Republic of China. Before 1978, China had made notable accomplishments in some sectors like public sanitation and flood control, but its overall record in environmental management was very weak. Questions remain concerning whether the reforms: (1) aggravated the already poor environmental conditions (air and water pollution, degradation of forests and grasslands, decline of wildlife populations); (2) succeeded in spurring economic development; and (3) occurred at the cost of environmental decline. Extensive research in China and careful reading of primary materials make it clear that several areas central economic planning versus increased local autonomy, the growth of local small-scale industry, environmental legislation, and the change in leadership itself. (Airone-PTT)
W88-01813

OPERATION AND MAINTENANCE OF WATER SYSTEMS IN DEVELOPING COUNTRIES,
Agency for International Development, Washington, DC.
For primary bibliographic entry see Field 5F.
W88-01890

INCREASING WATER SUPPLIES IN THE IBERIAN PENINSULA,
For primary bibliographic entry see Field 6D.
W88-01892

IMPACTS OF MULTI-JURISDICTIONAL AGREEMENTS AND EFFLUENT DISPOSAL BY CITRUS IRRIGATION ON THE DEVELOPMENT OF AN INDUSTRIAL WASTE PRETREATMENT PROGRAM,
Boyle Engineering Corp., Orlando, FL.
E. L. Melear, H. W. Persons, and T. L. Lothrop.
IN: Proceedings of the 40th Industrial Waste Conference, Purdue University, West Lafayette, Indiana, May 14-15, 1985. Butterworths, Boston, MA. 1985. p 279-285, 4 tab.

Descriptors: *Legislation, *Legal aspects, *Waste disposal, *Wastewater treatment, *Orlando, *Florida, Water pretreatment, Wastewater irrigation, Citrus, Regulations, Water reuse, Wastewater renovation, Local governments.

The City of Orlando, Florida, has developed an industrial waste pretreatment program (IWPP) to monitor and control non-residential discharges to its collection system and wastewater treatment plants. Program development was impacted by sludge disposal limits, stringent discharge standards for effluent reuse and wasteload allocations for Class III surface waters. Uniform program enforcement was complicated by inter-local multi-jurisdictional agreements with wholesale customers outside the municipal jurisdiction. EPA has mandated that the elements of both the Sewer Use Ordinances and IWPPs of the city, and all contributors to the city's wastewater treatment plants must be compatible and comply with the general pretreatment regulations (40 CFR 403). Additional stringent local pollutant discharge standards have been established for metals and several priority and conventional pollutants to insure acceptable levels of effluent and sludge compatible with disposal plans. Additional data will be collected and analyzed to refine local pollutant limits, and efforts will continue to develop and enforce uniform and consistent industrial waste standards for all dischargers to the city's wastewater system. Through programs such as this, the city can continue to develop innovative wastewater reuse options to satisfy growth requirements in an environmentally sound matter. (See also W88-02132) (Lantz-PTT)
W88-02160

STRATEGIES FOR RIVER BASIN MANAGEMENT: ENVIRONMENTAL INTEGRATION OF LAND AND WATER IN A RIVER BASIN.
For primary bibliographic entry see Field 6A.
W88-02227

RIVER BASIN STRATEGY FOR COORDINATED LAND AND WATER CONSERVATION: SYNTHESIS AND CONCLUSIONS,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
For primary bibliographic entry see Field 6A.
W88-02228

LEGAL AND ADMINISTRATIVE TOOLS FOR RIVER BASIN DEVELOPMENT,
G. J. Cano.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 189-199, 1 fig, 26 ref.

Descriptors: *Legal aspects, *River basin development, *Water management, Water resources development, Jurisdiction, International waters, Interstate rivers, Water law, Resources development.

An analysis is made regarding the applicability or non-applicability of 'the river basin approach' from the institutional point of view (institutions include law and administrative organizations). The energy factor in connection with river basin development is considered. Functional and territorial interjurisdictional problems are examined separately, and examples are given. Three different cases of territorial interjurisdiction are described: (a) national (non shared) river basins; (b) national shared river basins (interstate or interprovincial rivers); and (c) international river basins. The present status of international river law, and of the organization of institutions to manage international river basins are also examined. The influence of water and air as factors of interdependence among all natural resources related to each river basin preside the work. Recommendations are made of legal tools needed to reach resiliency in the use of waters following changes in land and water use patterns. (See also W88-02227) (Author's abstract)
W88-02246

LEGAL, ADMINISTRATIVE AND ECONOMIC TOOLS FOR CONFLICT RESOLUTION, PERSPECTIVES ON RIVER BASIN MANAGEMENT IN INDUSTRIALIZED COUNTRIES,
York Univ. (England). Dept. of Economics.
A. Williams.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 201-208.

Descriptors: *Legal aspects, *Water management, *Water rights, *River basin development, *Economic aspects, *Competing use, Water law, Water use, Cost analysis.

Alternative mechanisms for the resolution of conflict between competing uses and users of river basins need to be judged by their respective effects on efficiency, equity, and macro-economic policy. Efficiency should go beyond financial considerations, and assess true real resource costs and all benefits whether or not reflected in revenues. Equity concerns compensation for loss of legitimate expectations as well as equal treatment of equals and distributive justice. Macro-economic policy concerns effects on inflation, unemployment, balance of payments, etc. Legal and administrative measures involve a prior assignment of rights, duties, powers, etc., and then some expectations about the nature of the transactions that will occur between the various parties in the light of that prior assignment. Market mechanisms can be analyzed in the same way. Various possible structures and types of interaction are then explored, from which it is concluded that no system is likely

to work well unless it ensures that all decision-makers are put in a position where they have to weigh all the costs and benefits generated by their actions, and not just those that accrue to them themselves. (See also W88-02227) (Author's abstract)
W88-02247

ENVIRONMENTAL CONFLICTS: STRUCTURE AND MANAGEMENT,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
For primary bibliographic entry see Field 6D.
W88-02248

PROBLEMS OF WATER REALLOCATION IN THE COLORADO - AMERICA'S MOST FULLY UTILIZED RIVER,
Utah Agricultural Experiment Station, Logan. International Irrigation Center.
For primary bibliographic entry see Field 6D.
W88-02249

CONFLICT BETWEEN FLOOD AND DROUGHT PREPAREDNESS IN THE COLORADO RIVER BASIN,
California Univ., Los Angeles. School of Engineering and Applied Science.
For primary bibliographic entry see Field 6D.
W88-02250

MAKING AND THE BREAKING OF AGREEMENT ON THE GANGES,
Open Univ., Milton Keynes (England).
B. Crow.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 255-264, 2 tab, 17 ref.

Descriptors: *Ganges River, *India, *Water law, *Ganges Water Treaty, Social aspects, Political aspects, Water supply, Irrigation, River basin development.

Some of the political circumstances which have influenced the making, in 1977, and the breaking, in 1982, of the agreement over sharing and development of the River Ganges. involve elements of two political battles: one, when agreement was reached, over the minimum flow Bangladesh would accept, and a second, when the area of agreement was reduced, over the guaranteeing of that share. The social group which appears to be most influential in determining the nature and setting the time scale for river development in South Asia. includes the 'rich peasants' who are the masters of the countryside in the most dynamic areas of India - Punjab, Haryana, Western UP, parts of Andhra Pradesh and of Tamil Nadu. It is in these areas that irrigation has been extended most rapidly. The paper concludes that conceptions of the 'national interest' and expressions of class interests require careful analysis if the timing and nature of river development decisions are to be understood. (See also W87-1034) (Lantz-PTT)
W88-02252

DIFFERENT TYPES OF RIVER BASIN ENTITIES - A GLOBAL OUTLOOK,
Food and Agriculture Organization of the United Nations, Rome (Italy).
S. Burchi.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 293-298, 5 ref.

Descriptors: *River basin development, *Management planning, *Water policy, Economic aspects, Social aspects, Water resources development, Commissions, Water law, Institutions.

The various kinds of river basin entities established in different regions of the world are classified in three main groups, namely, (a) valley authorities, with responsibility for broader economic and social development basin-wide; (b) basin entities, responsible in varying degrees for water resources management at the basin level; and (c) coordinating commissions or committees, established with the aim of brining harmony in water policies and plans at the basin level. Various cases illustrating the three classes of basin entities are drawn from the experience of various countries. In view of the great diversity found, it is not possible to draw any general conclusion. It is worth recalling, however, that the United Nations Interregional Seminar on Water Resources Administration held in New Delhi in 1973 endorsed a two-tier type of water resources administration with coordination at the national level and decentralization at the regional or basin level (UN 1975) - a model which seems to correspond to the approach followed in England and Wales, Hungary, or the German Democratic Republic. (See also W88-02227) (Author's abstract)
W88-02256

THAMES BASIN, ENGLAND - LEGAL AND ADMINISTRATIVE SYSTEM,
C. S. Sinnott.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 307-310.

Descriptors: *Thames River, *England, *Legal aspects, *River basin development, *Administrative decisions, Land use, Water use, Water resources development, Ecological effects.

The legal and administrative systems for land use and for the control of water resources in England are reviewed. Study of interaction between land use and water use reveals that in a developed river basin most new developments are relatively small and incremental to the already heavily exploited resource system. The impacts of two major land use proposals, anew town and an airport, are discussed to illustrate the issues which arise. (See also W88-02227) (Author's abstract)
W88-02258

RELEVANCE OF RIVER BASIN APPROACH FOR COORDINATED LAND AND WATER CONSERVATION AND MANAGEMENT,
Hydroconsult International, New Delhi (India).
K. V. Krishnamurthy.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 311-315.

Descriptors: *River basin development, *Land resources, *Water conservation, *Soil conservation, *Management planning, *India, Water resources development, Administrative agencies, Competing use, Water transfer, Water supply, Water demand.

The historical evolution of the concept of river basin development, in general, and in particular reference to India, is briefly reviewed. The basis of river basin development in India, particularly since 1947, is a key concept in regional development both in agriculture and industry. The Damodar Valley Corporation is cited as an example. A number of conflict situations are outlined - conflicts of a regional nature, important upstream modifications having downstream repercussions; work on one bank affecting the other bank etc. The nature of the functional conflicts are briefly alluded. The limitations of the river basin approach are seen against the recent emergence of an approach of interbasin transfer of water. A national perspective was recently evolved by Government of India. While a strict river basin approach is not now found entirely possible, necessitating a consideration of interbasin transfer of water, at the same time it cannot be stated that the concept is outdated because the basis for the determination of the possibilities of large scale transfer of water from one 'surplus' region to another 'deficit' region is in itself dependent on the river basin approach. (See also W88-02227) (Author's abstract)
W88-02259

RATIONALE FOR ESTABLISHING A RIVER BASIN AUTHORITY IN TANZANIA,
A. Mascarenhas.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 317-328, 1 fig, 1 tab, 13 ref.

Descriptors: *River basin development, *Tanzania, *Administrative agencies, Water resources development, Developing countries, Social aspects.

In a passive way, river basins have been used as a focus of activity since prehistoric times. With greater technical and engineering skills, some modern river basin development projects have stood out as triumphs of human skills. As developing countries, such as Tanzania, try to maximize their resources, care has to be taken, that the river basin authorities which are created, take into consideration both engineering as well as social and ecological factors. This paper attempts to illustrate that river basin authorities offer good opportunities for an integrated approach to planning. An authority should be able, among other factors, to balance the long term from the immediate benefits, reduce environmental risks and maximize social benefits. (See also W88-02227) (Author's abstract)
W88-02260

LAND APPLICATION OF MUNICIPAL WASTEWATER: IMPACTS OF WATER RIGHTS AND LAND-USE CONTROLS,
Virginia Water Resources Research Center, Blacksburg.
For primary bibliographic entry see Field 5E.
W88-02276

SOCIOECONOMIC FACTORS AFFECTING WATER CONSERVATION IN SOUTHERN TEXAS,
Washington State Univ., Pullman. Office of Applied Energy Studies.
For primary bibliographic entry see Field 3D.
W88-02317

MANAGEMENT OF HAZARDOUS WASTE: TREATMENT/STORAGE/DISPOSAL FACILITIES,
For primary bibliographic entry see Field 5D.
W88-02325

EMERGING STATE ROLES IN URBAN STORMWATER MANAGEMENT,
North Carolina Univ. at Chapel Hill. Dept. of City and Regional Planning.
E. J. Kaiser, and R. J. Burby.
Water Resources Bulletin WARBAQ, Vol. 23, No. 3, p 443-453, June 1987. 6 tab, 7 ref. NSF Research Grant CEE-8209884.

Descriptors: *Regulations, *Stormwater management, *Urban areas, *Drainage, *Urban hydrology, *Metropolitan water management, Maryland, New Jersey, Pennsylvania, Planning.

The technology of urban stormwater management has far outpaced its actual application in new urban development. This article documents that implementation gap, but shows that state and local governmental measures, particularly storm drainage regulations, can lead to improved performance in the private sector. Although state stormwater management programs are in their infancy, they are already having a measurable effect in stimulating the adoption of local governmental programs to manage urban storm water. Pioneering state programs in Maryland, New Jersey, and Pennsylvania, described in this article, provide models for states contemplating the formulation of stormwater management programs. (Author's abstract)
W88-02383

NATIONALIZATION AND EFFICIENT MANAGEMENT OF WATER RESOURCES IN IRAN,
Fayetteville State Univ., NC. School of Business and Economics.
A. Tavakoli.
Journal of Water Resources Planning and Manage-

ment JWRMD5, Vol. 113, No. 4, p 522-532, July 1987. 19 ref.

Descriptors: *Economic aspects, *Water law, *Nationalization, *Water resources management, *Iran, Regulations, Optimization, Agriculture, Farmers, Costs.

In Iran the government under the Shah's regime nationalized the water resources of the country and legislated a detailed statute concerning the development, allocation, and use of this limited resource. This paper critically examines the Nationalization of Water Resources Act (NWRA) from the standpoint of promoting economic efficiency. A historical study of past water laws reveals a strong philosophical link with the concept of nationalization. The NWRA denounces the market mechanism and centralizes all aspects of development, allocation, and use of this resource. The analysis reveals that efficiency and optimality in the allocation and use of water cannot be attained through these laws. A review of the performance of a number of water agencies that were established prior to the NWRA shows that they are successful in gaining the advantage of economies of scale, internalization of external effects, and reduction of waste. Under these systems, the farmers have the ultimate discretion with regards to allocation, use, and transfer of water. (Author's abstract)
W88-02417

6F. Nonstructural Alternatives

WATER AND THE MICHIGAN ECONOMY: MANAGING WATER QUALITY,
Michigan State Univ., East Lansing. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W88-01758

FIGHT AGAINST INDUSTRIAL AND URBAN POLLUTION IN THE ARTOIS - PICARDIE BASIN,
Artois-Picardie Water Agency, Douai (France).
For primary bibliographic entry see Field 5G.
W88-01931

SEEKING A NEW BALANCE IN THE DETERIORATING UPPER CITARUM BASIN,
West Java Provincial Planning Office, Bappeda (Indonesia).
B. Bronckhorst.
IN: Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin. D. Reidel Publishing Co., Dordrecht, Holland. 1985. p 71-79, 3 fig.

Descriptors: *Upper Citarum basin, *River basin development, *Indonesia, *Water resources development, Public education, Economic aspects, Agriculture, Water use, Water demand, Urban areas, Population density, Public opinion, Public policy.

The Citarum basin in West Java has been increasingly strained by rapid population increase and uncontrolled urban growth of Bandung, second city of Indonesia. Development has come to a point of overpopulation of the watershed. In the wake of economic recession urban dwellers are moving out and becoming farmers on the mountain slopes, bringing ever larger slope surfaces under cultivation. The paper describes the emerging problems, especially heavy hillside erosion and severe valley inundations during heavy rains. It discusses the problems of integrated regional planning to replace sectorial planning in specialized sectors. In the efforts of creating a better understanding of nature supportive activities among people, the traditional puppet theatre, wayang, is being used as a powerful intermediary in the communication process. (See also W88-02227) (Author's abstract)
W88-02234

6G. Ecologic Impact Of Water Development

FILLING IN OF HARBOUR BASINS WHICH CONTAIN CONTAMINATED SILT,
Rotterdam Public Works Dept. (Netherlands).
For primary bibliographic entry see Field 5C.
W88-01526

ACCOMODATING ENVIRONMENTAL CONSTRAINTS--MODIFICATION OF A NAVIGATIONAL PROJECT IN COASTAL LOUISIANA,
Army Engineer District, New Orleans, LA.
D. F. Carney, and R. L. Gunn.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 96-101, 2 fig, 5 ref.

Descriptors: *Environmental effects, *Channels, *Navigation, *Louisiana, *Dredging, Hydraulic structures, Ecological effects, Wetlands, Bald eagle.

The Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana, Project was completed in 1981. It established a -6 m Navigation Geodetic Vertical Datum, 122-m-wide, 85-m-long navigational channel by the hydraulic dredging of approximately 40 million cu m of material. Project completion was the culmination of extensive interagency and interdisciplinary coordination in response to several environmental constraints. As originally designed, the project would have adversely impacted three active southern bald eagle nests, approximately 2,800 ha of wetlands, and a newly developing river delta. The following steps were taken to reduce or eliminate adverse environmental impacts: (1) creation of approximately 200 ha of marsh through the semiconfined disposal of dredged material in a freshwater lake; (2) preservation of approximately 1,120 ha of wetlands as a result of the modification of construction and disposal plans; (3) establishment of a 'No-Work Area' of 2.4 km from any active bald eagle nest during the nesting season of 15 October to 30 April; (4) prevention of disposal area development if such development might adversely affect the eagles; and (5) creation of approximately 200 ha of marsh through managed unconfined disposal within a rapidly growing river delta. The various Federal, State, and private natural resource agencies and navigational interests involved have been satisfied with the New Orleans District's efforts to accomodate these environmental concerns. (See also W88-01522) (Author's abstract)
W88-01532

BEACH RESTORATION ON SANDY HOOK, GATEWAY NATIONAL RECREATION AREA, FROM MAINTENANCE DREDGING OF AMBROSE AND SANDY HOOK FEDERAL NAVIGATION CHANNELS,
Army Engineer District, New York.
For primary bibliographic entry see Field 8A.
W88-01534

COASTAL AND INLET PROCESSES NUMERICAL MODELING SYSTEM,
Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 8B.
W88-01546

GROUNDWATER FLOW SUBMODEL FOR THE ANALYSIS OF REGIONAL WATER POLICIES IN OPEN-PIT LIGNITE MINING AREAS,
Technische Univ., Dresden (German D.R.). Inst. of Lignite Mining.
For primary bibliographic entry see Field 4B.
W88-01569

HYDROGEOLOGIC ASPECTS OF THE ABANDONMENT OF AN UNDERGROUND LEAD-ZINC MINE,
Idaho Univ., Moscow. Coll. of Mines and Earth Resources.
For primary bibliographic entry see Field 4B.
W88-01570

ARCHAEOLOGICAL ANALYSIS OF THE PROPOSED FLORENCE WATER TREATMENT PLANT,
Northland Research, Inc., Flagstaff, AZ.
W. S. Marmaduke, and T. S. Hartzell.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB87-235446, A05 in paper copy, A01 in microfiche. July 1987. 81 p, 14 fig, 1 tab, 76 ref. Bureau of Reclamation Contract No. 3-PA-30-00740.

Descriptors: *Archaeology, *Florence, *Arizona, *Water treatment facilities, History, Hohokam.

A Class I and III cultural resource literature search and survey was completed for the proposed site of the Florence Water Treatment Plant and its associated delivery lines, an area of about 22 acres. The project is an element of the Central Arizona Project. Three archaeological loci representing Hohokam use of the area were recorded in or near the project area. In order to evaluate the loci within the context of the intensive site investigations that have previously occurred in the Florence area, an extensive literature search was conducted regarding the Florence archaeological district. It was determined that the recorded loci represented elements of a site recorded by Gila Pueblo named 'Florence 7:8 (GP)', and that significant site deposits likely remain at one of the loci (Locus 2). The report primarily consists of a summary overview of previous site investigations in the Florence area, and a discussion of research directions and questions that remain to be addressed concerning sites in this area. (Author's abstract)
W88-01608

STUDIES IN THE HOHOKAM COMMUNITY OF MARANA.
Arizona State Univ., Tempe. Office of Cultural Resource Management.
Anthropological Field Studies, No. 15, April 1987. 311 p, 90 fig, 46 tab, 207 ref, 3 append. Bureau of Reclamation Contract No. 5-CS-30-02570. Edited by Glen E. Rice.

Descriptors: *Hohokam, *Marana, *Arizona, *Archaeology, History.

This is the final in a three volume series dealing with the 1985 Arizona State University excavations conducted at the 12th century Classic Hohokam community complex near Marana, Arizona. It includes analytical and synthetic discussion of geomorphology, chronometrics, house floor assemblages, craft production, subsistence pursuits, and burial practices. Residential sites, gathering camps, and dry-farm fields dispersed over an area of 20 sq mi are thought to have operated as part of a single community. A platform mound and six compounds which could contain elite residences and administrative facilities were not included in the ASU excavations. The households within the excavated portions of the community show a consistent emphasis on the surplus production of ceramic vessels. Households also specialize in different kinds of craft production activities, and are differently involved in the hunting of artiodactyls, tending of agave plants, and the farming of flood water fields. The report evaluates the hypothesis that the Marana complex is the central community in an early Hohokam chiefdom. (Author's abstract)
W88-01661

FIELD INVESTIGATIONS AT THE MARANA COMMUNITY COMPLEX.
Arizona State Univ., Tempe. Office of Cultural Resource Management.
Anthropological Field Studies, No. 14, March 1987. 203 p, 44 fig, 56 tab, 66 ref. Bureau of Reclamation Contract No. 5-CS-30-02570. Edited by T. Kathleen Henderson.

Descriptors: *Marana, *Arizona, *Archaeology, Hohokam.

The Marana Community is a complex of Hohokam sites dating to the 12th century A.D. Some of the sites effected by the Tucson reach of the Central Arizona Project were excavated by Arizona State University in 1985 with funding provided by the Bureau of Reclamation. Sampling coverage of site areas was provided through the use of back-hoe trenches and magnetometer mapping. Trench sample units are shown to provide reliable estimates of population parameters and to be more cost effective than magnetometer mapping. Six loci within the three sites are examined in detail through the use of horizontal block exposures. (Author's abstract)
W88-01662

BURIED IN THE BOTTOMS: THE ARCHAEOLOGY OF LAKE CREEK RESERVOIR, MONTGOMERY COUNTY, TEXAS,
Texas Archeological Survey, Austin.
L. C. Bement, R. D. Mandel, J. F. de la Teja, D. K. Utley, and S. A. Turpin.
Texas Archaeological Survey Research Report No. 97, 1987. 207 p, 25 fig, 17 tab, 165 ref, 4 append. Bureau of Reclamation Contract No. 6-CS-50-05340.

Descriptors: *Archaeology, *Lake Creek Reservoir, *Texas, History, Ethnohistory.

In 1986, The University of Texas at Austin, conducted a cultural resources assessment for the proposed Lake Creek Reservoir, Montgomery County, Texas. The project incorporated geomorphological, ethnohistorical, historical, and archaeological studies with a sample pedestrian survey of 3570 acres -- roughly 20% of the reservoir area -- to predict the nature and density of cultural resources to be affected by reservoir construction. Deposits within the Lake Creek Basin represent Late Pleistocene, Early and Late Holocene periods with Middle Holocene age deposits either missing or, more likely, restricted to the deeply buried deposits of the floodplain. The potential for site deposits representing all periods of cultural exploitation is contained in the Lake Creek area. Pedestrian survey, coupled with intensive shovel probing, located and recorded 46 prehistoric sites -- four with historic Anglo components. Ethnohistorically, Lake Creek lay within the range of the Akokisa, hunters and gatherers who practiced a seasonal round, summering on the coast and wintering inland, but no specifically named villages or camps were found in the study area. The high propensity for floods and the inhospitable environment of the Lake Creek bottoms discouraged European settlement in the floodpool. Only one historic component, the former site of a hardwood mill, predates 1940. The historic potential in the reservoir is limited to mill sites and isolated burials associated with the timber industry. The sparse Spanish and Anglo references to the Akokisa were incorporated into models of prehistoric adaptation. This model is theoretically based in the ethnographic studies of Dalton and Binford with regional support drawn from Aten's summary of coastal archaeology and excavations in Livingston and Honea reservoirs. The research design for further work in the Lake Creek Reservoir is based on a set of expectations that can only be tested by subsurface sampling. Eight sites located by the 20% survey were recommended for limited testing in conjunction with intensive survey of the remaining area within the reservoir. (Author's abstract)
W88-01663

I. POTENTIAL EFFECTS OF PARTIAL WATER WITHDRAWALS FROM THE VERDE RIVER ON RIPARIAN VEGETATION,
Arizona State Univ., Tempe.
J. H. Brock.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB87-224325, A06 in paper copy, A01 in microfiche. 27 p, 1 fig, 2 tab, 55 ref.

Descriptors: *Water resources development, *Riparian vegetation, *Selective withdrawal, *Verde River, *Arizona, Water table, Water deficit, Water use, Flow profiles.

Diversions of water from the Verde River are planned to satisfy water allocations to users made possible by the Central Arizona Project. Any diversion has the potential effect of lowering the water table and negatively impacting riparian vegetation associated with the stream channel. It is proposed to reduce flow rates by 3.6 cfs on the East Verde River to 22.8 cfs above Horseshoe Lake near Tangle Creek on the Verde River, while 10.5 cfs would be diverted from the Verde River near Paulden. These diversions would lower the water level in the streams by 1.4, 3.5 and 3 inches respectively on the East Verde River, at Tangle Creek and Paulden. Flow reductions of this magnitude should have minimal effect, even during low flow periods (June and July) on riparian vegetation. The diversions remove minute quantities of water especially during peak flows when the stream bed would be resaturated and during low flows, the reduced flow rate may be compensated by in-bank storage and subsurface flows. Riparian soils are coarse and have good lateral transport of waters allowing for rapid recharge. Reduced water levels of a maximum of 4 inches would have minimal effect on established riparian plants. Regeneration would be limited to the perimeters of channels bearing water in all but exceptionally wet years. The overall impact of the proposed action on riparian vegetation along the Verde River is so slight that it could not be detected using state-of-the-art vegetation monitoring methods. (Author's abstract)
W88-01670

II. STRUCTURE OF RIPARIAN HABITATS AT SELECTED SITES ALONG THE VERDE AND EAST VERDE RIVERS OF CENTRAL ARIZONA,
Arizona State Univ., Tempe.
J. H. Brock.
Available from the National Technical Information Service, Springfield, VA. 22161. 83 p, 8 fig, 31 tab, 55 ref.

Descriptors: *Water resources development, *Riparian vegetation, *Selective withdrawal, *Verde River, *Arizona, Water table, Water deficit, Water use, Flow profiles.

Three layers of vegetation; trees, shrubs and herbaceous, comprising the riparian habitat along the Verde and East Verde Rivers were sampled between October 1985 and July 1986. The data were collected to help describe the vegetation communities on the banks of these 2 major central Arizona streams. Stands of riparian forests are scattered along both rivers, with the most extensive being in the Verde Valley between the Tapco and Camp Verde areas. Fremont cottonwood, Goodding willow, salt cedar, and velvet mesquite were common trees along the Verde River. Along the East Verde River, especially at higher elevations, Arizona alder was common, while Arizona sycamore and Goodding were common along the entire stream. The most common young tree on the Verde River was Fremont cottonwood, while on the East Verde River, Arizona sycamore and velvet ash were the common young trees. Shrubs formed a minor component of the riparian habitat along both rivers. The most common shrub was seep willow. The herbaceous layer was dominated by grasses with few forbs (herbaceous broadleaf plants). On both rivers, the soil surface was often bare. The overall average bare surface on the Verde River was 42% and 59% of the surface was bare on the East Verde River sites. Best riparian habitat, based on community structure and a canopy volume index was found in Verde Valley. The remainder of the river was rated as good but many parts were considered to be only fair habitat. All areas sampled on the East Verde River were fair habitat based on the canopy volume index. Habitat diversity was present along both rivers in the form of trees, shrubs and herbaceous vegetation. Overall, improved management of the river is needed to assure healthy riparian plant communities. Abusive use by livestock, recreationists and, at local points, mining, needs to be corrected through better natural resources planning and management of not only the river flood plain but also the watershed of the Verde River drainage basin. (Author's abstract)
W88-01671

PLAN FOR ARCHAEOLOGICAL INVESTIGATIONS AT HISTORIC DAM CONSTRUCTION CAMPS IN CENTRAL ARIZONA.
Dames and Moore, Phoenix, AZ.
Available from the National Technical Information Service, Springfield, VA. 22161. May 1987. 84 p, 18 fig, 4 tab, 18 ref. Edited by A. E. Rogge and Cindy L. Myers.

Descriptors: *Archaeology, *Dams, *Arizona, History, Water storage.

In June 1986, the Bureau of Reclamation awarded a three-year contract to undertake historical archaeological studies as part of the mitigation program for the Regulatory Storage Division (Plan 5) of the Central Arizona Project. This report presents a plan for guiding this research which will investigate about 45 archaeological sites. The proposed primary goal is to produce a social history of life in temporary construction camps at seven major water storage dams built in central Arizona from the 1890s to 1940s. Investigations of demography, daily life, work environments and ethnic relations are identified as research themes. The sites to be studied are described, and methodologies for pursuing archaeological fieldwork, historic research and laboratory analysis are discussed. (Author's abstract)
W88-01673

INFLUENCE OF STAGNATION OF WATER PATHWAYS ON MOSQUITO POPULATION DENSITY IN CONNECTION WITH MALARIA TRANSMISSION IN THE SOLOMON ISLANDS,
Kyung Hee Univ., Seoul (Republic of Korea). Dept. of Parasitology.
Y.-H. Paik.
The Japanese Journal of Experimental Medicine JJEMAG, Vol. 57, No. 1, p 47-52, February 1987. 4 fig, 1 tab, 4 ref.

Descriptors: *Water management effects, *Stagnant water, *Public health, *Mosquitoes, *Malaria, *Human diseases, Aquatic insects, Water management, Solomon Islands, DDT, Guadalcanal, Flow discharge, River mouth, Ecological effects, Insecticides.

Malaria is the major health problem in the Solomon Islands. The area of Guadalcanal plains is known as the most malarious area of the Solomons. In spite of well executed DDT indoor spraying, malaria transmission was not interrupted. The causative factors responsible for the persisting transmission appeared to be: (1) refractoriness of Anopheles farauti to DDT spraying; (2) the habit of people to stay outside late in the evening; and (3) a marked outdoor biting tendency of A. farauti. It was found that DDT indoor spraying alone had little impact on the interruption of malarial transmission. The study was conducted in 1974 to observe the change of mosquito population density in relation to the constriction of the river mouth in north Guadalcanal in order to consider alternative means for malaria control. The results indicate that the improvement of the malaria situation in north Guadalcanal could be associated with the steady flow of the river water obtained by maintaining the river mouth in the open condition. (Author's abstract)
W88-01712

CRITICAL ASSESSMENT OF THE INFLUENCE OF MANAGEMENT PRACTICES ON WATER QUALITY, WATER TREATMENT, AND SPORT FISHING IN MULTIPURPOSE RESERVOIRS IN KANSAS,
Kansas Water Resources Research Inst., Manhattan.
S. J. Randtke, F. de NoyeUes, D. P. Young, P. E. Heck, and R. R. Tedlock.
Available from the National Technical Information

Service, Springfield, VA 22161, as PB87 229522/AS. Price codes: A09 in paper copy, A01 in microfiche. Contribution No. 252, September 1985. 171 p, 5 tab, 491 ref. Contract No. 14-08-0001-G907. Projection No. USGS G907-04.

Descriptors: *Kansas, *Multipurpose reservoirs, *Water quality control, *Sport fishing, Fish management, Water treatment, Water supply, Model studies, Drinking water.

Many cities in Kansas, especially in the eastern portion of the state, rely upon impounded surface-water supplies for their drinking water. Many of the reservoirs are either multipurpose reservoirs or under pressure to become multipurpose reservoirs, accommodating water-based recreation and, in particular, sport fishing. Traditionally, these reservoirs have been managed primarily to protect the quality of drinking water, with relatively little regard for fish production, but there is now an increasing desire to include enhancement of sport fishing as a major management objective. Unfortunately, protection of drinking water quality and enhancement of sport fishing are not completely compatible objectives, although there are major areas of agreement and areas where some compromise is appropriate. To satisfy both objectives, it is necessary for reservoir managers to have a clear understanding of the potential impacts of their actions on water quality, water treatment, and sport fishing. This report examines the characteristics of reservoirs and sport fish in Kansas and then critically examines an array of management practices, assessing the potential impacts of each practice on raw and treated water quality, on the cost and difficulty of water treatment, and on sport fishing. The applicability of existing mathematical models to management of Kansas reservoirs is examined; and the report itself represents a conceptual model of the physical, chemical, and ecological functioning of Kansas reservoirs, providing a foundation for development of a regional reservoir management mode. Critical research needs are identified, and some suggestions are made as to possible experimental approaches. (Randtke-KS St. U, KWRRI)
W88-01764

RELATIONSHIP OF UPPER LETHAL TEMPERATURES TO SILICON CONTENT IN ECOLOGICALLY DIFFERENT HYDROBIONT SPECIES FROM CONTINENTAL WATERS,
Akademiya Navuk BSSR, Minsk. Inst. of Zoology.
N. N. Khmeleva, and Y. F. Mukhin.
Doklady Biological Sciences DKBSAS, Vol. 291, No. 1-6, p 659-662, May 1987. 2 fig, 1 tab, 9 ref. Translated from Doklady Akademii Nauk SSSR, Vol. 291, No. 5, p 1272-1275, December 1986.

Descriptors: *Silicon, *Cooling water, *Ecological effects, *Electric power production, *Thermal pollution, *Hot springs, Ostracods, Ecosystems, Temperature effects, Ecological effects, Lethal limits.

Intensive utilization of inland waters for energy needs frequently leads to substantial changes in aquatic ecosystems, such as anthropogenic warming. Inhabitants of hot springs are of undoubted interest for the solution of problems in effective use of warm effluent waters. The goal of this work was the simultaneous study of silicon content in several hydrobiont species and determination of their upper lethal temperatures. The work was conducted at the cooling reservoir of the Berezovskaya State Regional Electric Power Station (BSS) and at hot springs in Kamchatka and Zabaikal. Analyses for silicon were conducted with high accuracy by neutron-activated and atom-absorption methods. For the studied inhabitants, upper lethal temperatures were in the range of 34-70 degrees. However, the upper temperature limit of the animals' vital activities is < 50 C. Greatest temperature resistance among multicellular animals was shown by ostracods. Among the aquatic invertebrates studied, the most resistant to high temperature were nematodes, cyclopods, dragon-fly larvae, chironomids, Physella, and bryozoans. The ability of hydrobionts to survive higher temperatures tends to depend on their silicon content. The data are satisfactorily described by: $y = 37.91$ times e to the 0.0078x power, where y is dry weight silicon content and x is the upper lethal temperature. A turning point in silicon content is observed at 41-42 C. Study of the mechanisms that begin functioning in situations critical for an animal and a search for the environmental conditions that determine resistance to high temperature are necessary. Particular attention should be focused on studing the zone of ecological discomfort, where the unbalancing of many of an organism's biological processes occurs. (Airone-PTT)
W88-01819

ENVIRONMENTAL IMPACT ANALYSIS AS RELATED TO RIVER BASIN MANAGEMENT,
Pennsylvania Univ., Philadelphia. Dept. of Systems Engineering.
W. A. Lyon.
Water Pollution Control Assoc. of Pa. Magazine, Vol. 20, No. 4, p 17-21, July-August 1987.

Descriptors: *Environmental impact, *Legislation, *National Environmental Policy Act, *United States, *Canada, Regulations, Resources management.

The status of the environmental impact process as it applies to river basin management is reviewed. The American and Canadian experience in connection with this process, new issues, methods and problems us in connection with this analytical tool are discussed. Prior to the passage in 1969 of the National Environmental Policy Act in the U.S. and the emergence of similar policies in Canada, projects related to river basin management were decided primarily on a cost-benefit analysis basis. The realization that many projects cause adverse impacts on elements of the natural and human environment that were not considered prior to the project led to the passage of the Environmental Policy Act. The role of standards, research needs, examples of outstanding and post-hoc analysis, cumulative impact analysis, and legislative design are aspects of this legislation briefly discussed. (Lantz-PTT)
W88-01886

TOWARDS A WATER BALANCE IN THE CENTRAL AMAZONIAN REGION,
Universidade Estadual Paulista, Botucatu (Brazil). Faculdade de Ciencias Agronomicas.
For primary bibliographic entry see Field 4C.
W88-01887

BIOLOGY OF STREAMS AS PART OF AMAZONIAN FOREST ECOLOGY,
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
For primary bibliographic entry see Field 2E.
W88-01888

TIDAL POWER GENERATION IN THE FUNDY REGION,
Bowling Green State Univ., OH.
For primary bibliographic entry see Field 8C.
W88-01925

ECOSYSTEM MODELLING OF A RIVER BASIN,
Economic and Social Commission for Asia and the Pacific (UN), Bangkok (Thailand).
For primary bibliographic entry see Field 6A.
W88-02230

ECOSYSTEM APPROACHES TO RIVER BASIN PLANNING,
Inland Waters Directorate, Ottawa (Ontario). Water Planning and Management Branch.
For primary bibliographic entry see Field 6A.
W88-02231

PROBLEMS OF LAND USE AND WATER RESOURCES MANAGEMENT IN THE UPPER TANA CATCHMENT IN KENYA,
Natural Resources Development Conservatory, Nairobi (Kenya).
For primary bibliographic entry see Field 4D.
W88-02239

CHANGING ILLINOIS RIVER,
Illinois Univ. at Urbana-Champaign. Water Resources Center.
For primary bibliographic entry see Field 5C.
W88-02244

URBAN HYDROLOGY: A MULTIDISCIPLINARY PERSPECTIVE,
For primary bibliographic entry see Field 4C.
W88-02326

OPTIMAL CANAL LOCATION USING ENVIRONMENTAL MAPPING,
Lower Colorado River Authority, Austin, TX. Water Policy and Programs Div.
For primary bibliographic entry see Field 6A.
W88-02416

7. RESOURCES DATA

7A. Network Design

DISCUSSION OF GROUNDWATER MONITORING,
Environmental Data, Inc., Grand Rapids, MI.
L. N. Halfen.
IN: Sludge and Its Ultimate Disposal. Ann Arbor Science, Ann Arbor, MI. 1981. p 241-257, 10 fig, 13 ref.

Descriptors: *Groundwater quality, *Water quality, *Monitoring, Sampling, Standards, Water analysis, Geohydrology, Groundwater recharge, Test wells, Site selection.

Effective groundwater monitoring is a multifaceted enterprise involving attention to technical detail in every phase. Each of the phases - well site selection, casing and screen installation, water sampling, analytical procedures and data interpretation - must be done in a fashion appropriate to achieve the desired goal. Groundwater is not a static commodity; rather, it is part of a hydrologic cycle involving recharge and discharge of water stored in subsurface horizons. This concept should be kept in the forefront of a groundwater study to avoid the pitfalls of incomplete data and inaccurate interpretations, even when great care is taken in other aspects of the program. The most important application of this axiom occurs early in all groundwater monitoring programs, when the locations for wells are selected. Factors that influence the hydrologic cycle include, but are not limited to, total and periodic precipitation, runoff, soil permeability, evapotranspiration, subsurface strata and temperature. Other variables frequently apply also, including the nature and amount of contaminants, if any are present; local land use and development; and access to the site. Clients react positively when their groundwater consultant demonstrates his expertise by obtaining relevant and valid data from a minimum number of wells. Not only can the operational alternatives be considered promptly, but there is the added benefit of cost-effectiveness. The role of regulatory agencies and groundwater guidelines, sampling, parameter selection, laboratory analysis, and data interpretation are discussed. (See also W88-01499) (Lantz-PTT)
W88-01518

SILT CONCENTRATION MEASUREMENTS,
Rotterdam Public Works Dept. (Netherlands).
C. Boodt.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 52-61, 7 fig, 6 ref.

Descriptors: *Silt, *Dredging, *Sedimentation, *Port of Rotterdam, Dredging, Costs, Environmental effects, Channels, Navigation, Silt concentration, Silt load.

In the area of the Port of Rotterdam a number of possible means of reducing the costs which arise from the need for maintenance dredging and of reducing costs resulting from environmental problems are being investigated. The reduction in costs which is envisaged can be achieved by taking measures to limit or concentrate siltation or to improve the efficiency and effectiveness of dredging and disposal operations. To this end a number of possibilities are being considered. In order to investigate means of limiting siltation or concentration, simulations of all conditions must be conducted. It is therefore essential that the relevant processes and boundary conditions be described and that sufficient observations of the significant parameters are available. For one of these parameters, silt concentration, it appeared that there were very few records available and that there was no system for analysis and presentation. An information system has been designed, which enables determination of the silt concentration over an extended time period. This paper indicates the present state of development of this system and shows that the knowledge which has been gained so far can contribute to the solution of other problems in which the same parameters are significant. (Lantz-PTT)
W88-01527

SPATIAL DISTRIBUTION AND ANALYSIS OF GROUNDWATER NITRATE CONTAMINATION IN KALAMAZOO COUNTY, MICHIGAN,
Michigan State Univ., East Lansing. Center for Remote Sensing.
For primary bibliographic entry see Field 5B.
W88-01763

7B. Data Acquisition

ESTABLISHING A SLUDGE SAMPLING PROGRAM,
Western Michigan Environmental Services, Inc., Holland, MI.
For primary bibliographic entry see Field 5D.
W88-01505

CONCEPTS, COSTS AND USES OF GAS CHROMATOGRAPHY AND GAS CHROMATOGRAPHY/MASS SPECTROSCOPY IN THE ANALYSIS OF SLUDGE,
Environmental Research Group, Inc., Ann Arbor, MI.
For primary bibliographic entry see Field 5A.
W88-01506

CASE HISTORY OF SAMPLING PROBLEMS IN A SLUDGE LAGOON,
Environmental Control Technology Corp., Ann Arbor, MI.
For primary bibliographic entry see Field 5A.
W88-01507

SILT CONCENTRATION MEASUREMENTS,
Rotterdam Public Works Dept. (Netherlands).
For primary bibliographic entry see Field 7A.
W88-01527

FIELD FACILITIES FOR SUBSURFACE TRANSPORT RESEARCH,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2F.
W88-01605

COASTAL-ZONE-COLOR-SCANNER (CZCS) IMAGERY FROM NORTHWEST AFRICAN UPWELLING,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
B. Sturm, and P. Schlittenhardt.
IN: International Symposium on the Most Important Upwelling Areas off Western Africa (Cape Blanco and Benguela), Volume 1, 1985. p 253-280, 15 fig, 1 tab, 22 ref.

Descriptors: *Upwelling, *Coastal Zone Color Scanner, *Remote sensing, *Data acquisition, Satellite technology, Chlorophyll, Water temperature, Seasonal variation, Continental shelf, Maps.

During a joint project together with ESA, ORSTOM and CRODT, CZCS imagery has been received at the Nimbus-7 receiving station of ESA at Maspalomas (Gran Canaria) and processed at the JRC into synoptic maps of chlorophyll-like pigment concentration and relative sea-surface temperature. The area under consideration is the upwelling region offshore of Senegal during the period January to April 1983; two scenes from March 1981 and February 1982 have been included in this series. The imagery shows examples of some typical mesoscale phenomena present in upwelling areas: secondary upwelling at the shelf-edge and barotropic eddies having form and size which is predicted by theory. It is also found that gradients of sea-surface temperature coincide with gradients of pigment-concentration. However, the negative correlation between temperature and pigment concentration is inverted in some cases: at some pigment-temperature fronts higher pigment is found in warmer water. (See also W88-01615) (Author's abstract)
W88-01634

COMPARISON OF EARTH RESISTIVITY AND ELECTROMAGNETIC SURVEY METHODS,
Blasland and Bouck Engineering, Syracuse, NY.
T. E. Gass.
Water Well Journal WWJOA9, Vol. 41, No. 8, p 43,46-47, August 1987.

Descriptors: *Geophysics, *Resistivity, *Electromagnetic conductivity, *Data acquisition, *Comparison studies, Conductivity, Surveying instruments, Subsurface profiles, Profiles, Resistance, Measuring instruments.

Electrical resistivity has been used for several decades to delineate subsurface features such as buried stream channels, the configuration of alluvial filled valleys, and depth to the water table. The electrical resistivity method is used to measure the resistance to an electrical current through a section of earth material consisting of any combination of unconsolidated materials, consolidated materials, and fluids contained in the pore spaces, fractures or voids of these materials. The electromagnetic method allows the electrical conductivity of earth materials including the fluids that fill their pore spaces to be measured using a transmitter coil that radiates an electromagnetic field which produces eddy currents in the earth below the transmitter. A receiver coil measures the intensity of the secondary field which is generated by the eddy currents and which is proportional to the electrical conductance of the materials penetrated. Advantages and disadvantages of both systems are detailed. One of the most significant advantages of the electromagnetic method use is its speed as a reconnaissance tool which permits more intensive surveying than might be done with earth resistivity equipment. The electromagnetic system is capable of continuous recording of profile data up to depths of 15 m, while with resistivity techniques continuous measurements are impossible. However, electromagnetic methods are limited in terms of sounding capability and depth penetration. Electrical resistivity offers a superior sounding capability and the equipment is significantly less expensive than that required for the electromagnetic method. It is suggested, however, that the electromagnetic method will become increasingly popular for profile measurements up to 15 m. (Wood-PTT)
W88-01713

USE OF MULTI-LEVEL GAS DRIVEN SAMPLERS AND CONVENTIONAL MONITORING WELLS FOR EVALUATION OF GROUNDWATER CONTAMINATION AT AN UNCONTROLLED HAZARDOUS WASTE SITE,
NUS Corp., Pittsburgh, PA.
For primary bibliographic entry see Field 5E.
W88-01726

PERSISTENCE OF SYNTHETIC SOLVENT CONTAMINANTS IN A GLACIAL OUTWASH AQUIFER, WASHINGTON STATE,
Environmental Protection Agency, Seattle, WA. Region X.
For primary bibliographic entry see Field 5B.
W88-01734

MODELING GROUNDWATER FLOW BY MEANS OF A HYBRID TRAJECTORY IMAGE, BOUNDARY INTEGRAL EQUATION METHOD,
Purdue Univ., Lafayette, IN. Dept. of Earth and Atmospheric Sciences.
For primary bibliographic entry see Field 2F.
W88-01762

MONITORING METHODS ASSESSED FOR POWER PLANT WASTE STREAMS,
Electric Power Research Inst., Palo Alto, CA.
For primary bibliographic entry see Field 5D.
W88-01815

TWO SIMPLE MODELS FOR ESTIMATING DAILY MEAN WATER TEMPERATURES AND DIEL VARIATIONS IN A DANISH LOW GRADIENT STREAM,
Miljoestyrelsen, Silkeborg (Denmark). Freshwater Lab.
For primary bibliographic entry see Field 2H.
W88-01830

BACTERIAL SURVEY OF WELL WATER - TEHRAN, IRAN,
Tehran Univ. (Iran). School of Pharmacy.
M. Shariatpanahi, and A. C. Anderson.
Environmental Research ENVRAL, Vol. 43, No. 2, p 285-289, August 1987. 2 tab, 11 ref.

Descriptors: *Bacteria, *Tehran, *Iran, *Water pollution sources, *Groundwater quality, Water quality, Wastewater disposal, Fecal coliforms, Drinking water, Microbiological studies, Monitoring.

The city of Tehran, Iran, is located south of Mount Alborze on an alluvial plain. The city lacks municipal sewage facilities, with the only method of sewage disposal for industrial and domestic waste being through seepage pits, pit privies, and leaching cesspools. There is the potential for waste from these disposal sites to leach into the groundwater aquifer. The average distance between the water table and the bottom of the seepage pits within the city limits is about 20 m. The level, however, varies between north and south. Southern seepage pits are more likely to break through to the groundwater stratum because of the shallow groundwater level and because of saturated soil conditions during periods of heavy rainfall. One hundred and twenty-one wells throughout the city of Tehran were monitored during the four seasons of the year for the presence of bacterial indicators of fecal pollution. None of the sites monitored was connected to Tehran's main water distribution system, but represented drinking water sources for small communities, individual factories, hospitals, etc. Only 17 samples showed no indication of fecal bacterial contamination throughout the study. The remaining sites were positive for at least one of the following at some season of the year: Escherichia coli, Shigella sp., Citrobacter sp., Klebsiella-Enterobacter group, Clostridium perfringens, or Streptococcus faecalis. (Lantz-PTT)
W88-01880

DETECTION OF VOIDS BETWEEN STEEL LININGS AND CONCRETE,
For primary bibliographic entry see Field 8A.
W88-01909

COMPARISON OF GEOSTATISTICAL METHODS FOR ESTIMATING TRANSMISSIVITY USING DATA ON TRANSMISSIVITY AND SPECIFIC CAPACITY,
Ecole Nationale Superieure des Mines de Paris,

Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 2F.
W88-01912

USE OF CURRENT METERS FOR CONTINUOUS MEASUREMENT OF FLOWS IN LARGE RIVERS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2E.
W88-01914

SOME HYDROLOGICAL ASPECTS OF WEATHER RADAR RESEARCH IN THE UNITED KINGDOM,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W88-01964

APPLICATION OF ENZYME ASSAYS FOR TOXICOLOGICAL WATER TESTING (ANWENDUNG ENZYMATISCHER VERFÄHREN IN DER WASSER-TOXIKOLOGIE),
Stadtwerke Mainz A.G. (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W88-01972

MANUAL FOR DESIGN AND OPERATION OF A SOLENOID-BASED DELIVERY SYSTEM FOR AQUATIC TOXICITY TESTING,
Maryland Univ., Solomons. Chesapeake Biological Lab.
A. E. Pinkney, R. J. Klaud, and D. A. Wright.
Environmental Technology Letters ETLEDB, Vol. 8, No. 4, p 153-158, April 1987. 5 fig, 1 tab, 6 ref.

Descriptors: *Automation, *Analytical methods, *Toxicity tests, *Design criteria, Measuring instruments, Toxicity, Water pollution effects.

A solenoid-based sample delivery system for aquatic toxicity studies is easily constructed from readily available materials and has provided reliable concentrations in acute and chronic tests. This paper serves as a manual for the design, assembly, and operation of the system. The system can be modified for use with toxicants of varying water solubility, mixtures, effluents, and leachates from antifouling paint panels. (Author's abstract)
W88-02014

VARIATION IN APPARENT TRACE METAL COMPLEXING CAPACITY OF NATURAL WATERS WITH PLATING POTENTIAL USING ANODIC STRIPPING VOLTAMMETRY,
Western Australia School of Mines, Kalgoorlie.
For primary bibliographic entry see Field 2H.
W88-02015

CALIBRATION OF AN AIRBORNE LYMAN-ALPHA HYGROMETER AND MEASUREMENT OF WATER VAPOR FLUX USING A THERMOELECTRIC HYGROMETER,
California Univ., Irvine. Dept. of Mechanical Engineering.
C. A. Friehe, R. L. Grossman, and Y. Pann.
Journal of Atmospheric and Oceanic Technology, Vol. 3, No. 2, p 299-304, June 1986. 8 fig, 16 ref. NSF Grant ATM-8206904.

Descriptors: *Measuring instruments, *Hydgrometers, *Water vapor, *Weather, *Meteorolopical data collection, Calibration, Atmosphere, Humidity, Performance evaluation.

An improved calibration technique for an airborne Lyman-alpha hygrometer is presented. Like previous methods, it relies upon simultaneous measurement of absolute humidity determined from a slower response hygrometer. A substantial improvement in the Lyman-alpha calibration is obtained by accounting for the time lag of the slower instrument. To show the technique data from Lyman-alpha and thermoelectric devices on the NCAR Electra during an investigation of the nearly neutral boundary layer over the Arabian Sea as part of the WMO/ICSU Summer Monsoon Experiment. It is also shown that for near-neutral conditions the eddy-correlation water vapor flux can be adequately estimated using the fast response vertical velocity data from a gust probe and slower response data from the thermoelectric device, which has been properly advanced to account for the time lag. (Author's abstract)
W88-02043

NEW TECHNIQUE FOR THE STUDY OF CLOUD MICROSTRUCTURE,
National Center for Atmospheric Research, Boulder, CO. Research Aviation Facility.
D. Baumgardner.
Journal of Atmospheric and Oceanic Technology, Vol. 3, No. 2, p 340-343, June 1986. 4 fig, 11 ref.

Descriptors: *Clouds, *Measuring instruments, *Weather, *Meteorology, Atmosphere, Monitoring, Prediction, Spatial variation.

A technique is described by which the spacing of cloud particles can be measured using existing data from a cloud particle measurement probe. The monitor circuit used in this application is inexpensive and easy to build and connects easily to data systems already interfaced to particle measuring probes. Preliminary results show excellent agreement between predicted and measured spatial distributions of cloud droplets in adiabatic cloud regions but not always in mixed cloud regions on 10-m scales. This technique promises to be a valuable tool for the investigation of entrainment and other small-scale cloud microphysical processes. (Author's abstract)
W88-02044

DIRECT METHOD FOR DERIVING DROP-SIZE DISTRIBUTION AND VERTICAL AIR VELOCITIES FROM VHF DOPPLER RADAR SPECTRA,
Kyoto Inst. of Tech. (Japan). Dept. of Electrical Engineering.
K. Wakasugi, A. Mizutani, and M. Matsuo.
Journal of Atmospheric and Oceanic Technology, Vol. 3, No. 4, p 623-629, December 1986. 5 fig, 1 tab, 19 ref, append.

Descriptors: *Radar, *Drop size distribution, *Measuring instruments, *Doppler radar, *Raindrops, *Weather, *Meteorology, Atmosphere, Air velocity, Turbulence.

In precipitation environments, sensitive VHF Doppler radars have a capability to detect echoes from both refractive index irregularities and precipitation particles. The purpose is to propose a direct method to estimate the drop-size distribution N(D), the mean vertical air velocity and turbulence using Doppler spectra obtained by VHF Doppler radars. Because the new method directly estimates turbulence as well as the mean vertical air velocity, the N(D) parameters, deduced from a least-squares fit approach, are free from errors inherent in conventional measurements using microwave Doppler radars. Temporal and spatial variations of N(D) and mean vertical air velocity during a cold front passage are then studied to demonstrate the capability of the present method. (Author's abstract)
W88-02045

INFLUENCE OF RAINGAGE INTEGRATION TIME ON MEASURED RAINFALL-INTENSITY DISTRIBUTION FUNCTIONS,
Communications Research Centre, Ottawa (Ontario).
B. Segal.
Journal of Atmospheric and Oceanic Technology, Vol. 3, No. 4, p 662-671, December 1986. 9 fig, 2 tab, 28 ref.

Descriptors: *Rainfall rate, *Raingages, *Measuring instruments, *Weather, *Meteorology, Atmosphere, Canada, Probabilistic process.

Rainfall-rate statistics are frequently derived on the basis of raingage recordings having effective integration times of five minutes or more. The conversion of such data to equivalent statistics for an effective integration time of one minute is important in the prediction of microwave system performance. High-resolution tipping-bucket precipitation records for 45 locations in Canada have been analyzed to yield empirical conversion factors appropriate for five- or ten-minute sampling times. Two modes of expression are examined. In one, the ratio of equiprobable one-minute to tau-minute rainfall rates is treated as a function of their probability of occurrence, while in the other it is considered a function of the observed tau-minute rainfall intensity. In each instance the entire Canadian semicontinent could conveniently be divided into three characteristic regions with appropriate raingage correction factors for each region expressed in the form of a power-law over the range of practical interest. These results are compared with earlier efforts in Europe, Africa and Australia. (Author's abstract)
W88-02046

RETRIEVAL OF HORIZONTAL WIND FIELD AND MESOSCALE VERTICAL VORTICITY IN STRATIFORM PRECIPITATION BY CONICAL SCANNINGS WITH TWO DOPPLER RADARS,
Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
G. Scialom, and J. Testud.
Journal of Atmospheric and Oceanic Technology, Vol. 3, No. 4, p 693-703, December 1986. 9 fig, 1 tab, 20 ref.

Descriptors: *Precipitation, *Rainfall, *Radar, *Measuring instruments, *Weather, *Doppler radar, *Meteorology, *Vorticity, Atmosphere, Fronts, Winds.

Stratiform precipitations associated with fronts and squall lines are commonly observed by means of a single Doppler radar operating conical scannings. The data analysis is frequently the Velocity Azimuth Display-or VAD-methodology. This method directly yields, at each altitude, the horizontal wind vector at the center of the circle scanned by each radar gate, as well as its divergence and its stretching and shearing deformations at the circle scale. Also obtained are the terminal fall velocity of the hydrometeors, and, indirectly, the vertical velocity by integration of the air continuity equation. This paper deals with the case of two Doppler radars (spaced about 30 km apart) simultaneously operating conical scannings of stratiform precipitations. It is shown how a very simple extension of VAD analysis and its application to double radar yields the first derivatives of the horizontal wind and the mesoscale vertical vorticity. This new method, hereafter referred to as DVAD - or double VAD - analysis, is then illustrated by results gathered in the stratiform anvil at the rear of a tropical squall line observed during the 'COPT 81' experiment. (Author's abstract)
W88-02047

METEOR: AN ARTIFICIAL INTELLIGENCE SYSTEM FOR CONVECTIVE STORM FORECASTING,
Alberta Univ., Edmonton. Dept. of Computing Science.
R. Elio, J. De Haan, and G. S. Strong.
Journal of Atmospheric and Oceanic Technology, Vol. 4, No. 1, p 19-28, March 1987. 5 fig, 1 tab, 7 ref.

Descriptors: *METEOR, *Computer programs, *Weather forecasting, *Artificial intelligence, *Measuring instruments, *Weather, *Meteorology, Atmosphere, Prediction, Forecasting, Storms.

An experienced forecaster can use several different types of knowledge in forecasting. First, there is his theoretical understanding of meteorology, which is well entrenched in current numerical models. A second type is his 'local knowledge,' gained over years of experience, of how weather is likely to form in his forecast area. This kind of local familiarity is not easily captured with tradi-

tional numeric techniques, but might provide additional insights for prediction that someone unfamiliar with the area might not have. A third type of knowledge is how to interpret forecast tools already in use. This might include knowledge of the tool's limitations and how it works in a particular locale. Capturing these types of knowledge is important in building computing systems that can serve as intelligent consultants to forecasters. This paper describes a prototype system, called METEOR, that incorporates all these types of knowledge to predict the location, severity, and motion of convective storms in Alberta; METEOR interprets contoured maps of a synoptic-based instability index and of surface equivalent potential temperature. It also gathers additional information about a variety of ongoing weather conditions from three portions of surface aviation reports: the cloud cover section, the obstructions visibility, and the observations provided in the 'remarks' section. Interpreting remarks made by human observers, while useful to a forecaster experienced with local weather conditions, can be too time consuming for people to do in real-time and too complex for traditional computing methods to handle. However, METEOR interprets these remarks and keeps track of where various weather activities are occurring and how they are changing over time. At present, METEOR's final forecast is a prediction of likely areas of storm initiation, direction of motion, and intensity, plus summaries of current conditions and their implications for storm development. (Author's abstract)
W88-02048

94-GHZ DOPPLER RADAR FOR CLOUD OBSERVATIONS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
R. Lhermitte.
Journal of Atmospheric and Oceanic Technology, Vol. 4, No. 1, p 36-48, March 1987. 17 fig, 19 ref. Army Research Office Contract DAAG29-84-0145.

Descriptors: *Rainfall, *Radar, *Clouds, *Measuring instruments, *Weather, *Doppler radar, *Meteorology, Atmosphere, Transmitters, Remote sensing, Performance evaluation.

A Doppler radar operating at 3.2 mm wavelength was designed and assembled primarily for observation of clouds and precipitation. Phase detection of the radar signals which is required for Doppler operation is implemented through the use of a coherent oscillator phase locked on the transmitter pulse and used as a reference in the phase detector. The radar and associated signal processing techniques such as signal integrator and signal autocovariance estimator are discussed along with the Doppler performance of the radar. Also presented are the results of observation of ice and water clouds and also precipitation, which show the excellent Doppler capabilities of the radar in terms of accuracy of the mean Doppler and Doppler spectrum width. (Author's abstract)
W88-02049

TECHNIQUE TO MEASURE ENTRAINMENT IN CLOUD BY DUAL-POLARIZATION RADAR AND CHAFF,
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
W. R. Moniger, and R. A. Kropfli.
Journal of Atmospheric and Oceanic Technology, Vol. 4, No. 1, p 75-83, March 1987. 7 fig, 34 ref.

Descriptors: *Entrainment, *Clouds, *Radar, *Chaff, *Measuring instruments, *Weather, *Meteorology, Atmosphere, Reflectivity, Polarization.

A new method for studying the entrainment of air into clouds has been developed and tested, and initial results demonstrating the technique are presented. This new method is superior to other chaff techniques that allow air parcels to be followed only until the chaff reflectivity becomes indistinguishable from cloud reflectivity. Frequently this is soon after the chaff enters the cloud. The new technique uses circular depolarization ratio (CDR) measurements to avoid this limitation. Since the CDR of chaff is typically 20 dB greater than that of most hydrometeors, the signature provided by CDR allows chaff has disappeared. Circular polarization is superior to linear polarization in measurements such as these because the chaff signatures in circular depolarization do not require assumptions about chaff filament orientation, whereas interpretation of Z sub DR signatures (from linear polarization) does require such assumptions. The technique is discussed, and initial 8.6 mm wavelength radar measurements of chaff released near the base of a cumulus cloud are presented. These measurements demonstrate that the chaff can be distinguished from its CDR signature well after its reflectivity has been lost in the reflectivity of the cloud. Possible applications as well as limitations of the technique are discussed. An extension of the technique that offers the potential for qualitatively observing electrical fields in cloud is also discussed. (Author's abstract)
W88-02050

OBSERVATIONS OF THUNDERSTORM REFLECTIVITIES AND DOPPLER VELOCITIES MEASURED AT VHF AND UHF,
Clemson Univ., SC. Dept. of Physics and Astronomy.
M. F. Larsen, and J. Rottger.
Journal of Atmospheric and Oceanic Technology, Vol. 4, No. 1, p 151-159, March 1987. 8 fig, 1 tab, 20 ref. Air Force Office of Scientific Research Grant AFOSR-85-0216.

Descriptors: *Cloud physics, *UHF, *VHF, *Thunderstorms, *Radar, *Measuring instruments, *Weather, *Meteorology, Atmosphere, Reflectivity, Velocity, Storms, Rainfall, Performance evaluation.

Observations of thunderstorms made with two radars operating at different wavelengths of 70 cm and 5.67 m are compared. The first set of observations was made with the UHF radar at the Arecibo Observatory in Puerto Rico, and the second was made with the Max-Planck-Institut fur Aeronomie VHF radar in the Harz Mountains in West Germany. Both sets of observations show large echo strengths during periods of convective activity. Based on the observational data and calculations, precipitation completely dominates the UHF signals. In fact, a sensitive UHF radar such as at the Arecibo facility is a good tool for investigating cloud droplet distributions in the upper parts of the clouds. The signal at VHF has contributions from both precipitation and the turbulent scatter, and the two contributions can easily be separated since the droplet fall velocity and the updraft velocity are different, except for the smallest drop sizes. The results show that VHF and UHF are potentially a good combination of frequencies for cloud physics research. (Author's abstract)
W88-02051

FURTHER DISCUSSION ON DERIVING DROP-SIZE DISTRIBUTION AND VERTICAL AIR VELOCITIES DIRECTLY FROM VHF DOPPLER RADAR SPECTRA,
Kyoto Inst. of Tech. (Japan). Dept. of Electrical Engineering.
K. Wakasugi, A. Mizutani, M. Matsuo, S. Fukao, and S. Kato.
Journal of Atmospheric and Oceanic Technology, Vol. 4, No. 1, p 170-179, March 1987. 9 fig, 1 tab, 26 ref.

Descriptors: *Rainfall, *Drop size distribution, *Radar, *Measuring instruments, *Doppler radar, *Weather, *Meteorology, Atmosphere, Velocity, VHF, Japan.

Raindrop size distribution and vertical air velocity are directly derived from VHF Doppler radar spectra in precipitation environments. A least-squares fitting parametric estimation was used for VHF Doppler spectra to determine the distribution and air motions. After discussing further the VHF Doppler spectrum method, especially the effects of spectral broadening mechanisms, the method is applied to Doppler spectra obtained during the seasonal rain front (Bai-u front) observation in Japan. Variations of vertical air velocity and distribution parameters are discussed, based on this longer period dataset. (Author's abstract)
W88-02052

FIELD EVALUATION OF A DUAL-CHANNEL MICROWAVE RADIOMETER DESIGNED FOR MEASUREMENTS OF INTEGRATED WATER VAPOR AND CLOUD LIQUID WATER IN THE ATMOSPHERE,
Bureau of Reclamation, Auburn, CA. Sierra Cooperative Pilot Project.
M. Heggli, R. M. Rauber, and J. B. Snider.
Journal of Atmospheric and Oceanic Technology, Vol. 4, No. 1, p 204-213, March 1987. 8 fig, 3 tab, 14 ref. NSF Grant ATM-8407543.

Descriptors: *Field tests, *Radiometers, *Water vapor, *Cloud liquid water, *Measuring instruments, *Weather, *Meteorology, *Microwaves, Atmosphere, Performance evaluation, Clouds.

The dual-channel microwave radiometer is evaluated in regard to the measurement of integrated water vapor and supercooled liquid water. The study includes comparisons of integrated vapor content measured by the radiometer and rawinsondes as part of the Sierra Cooperative Pilot Project in the central Sierra Nevada. In addition, two radiometers with virtually identical characteristics were brought together on the Colorado Orographic Seeding Experiment at Steamboat Springs, Colorado, in order to study the stability and comparability of integrated vapor and liquid measurements. Comparison of vapor measurements by the radiometer and by rawinsonde yielded a correlation coefficient of 0.94, and a rms difference of 0.08 cm. There were no significant differences between results for paired data gathered in storms in the presence of supercooled liquid water and for paired data gathered on clear days under more ideal conditions. The collocated-radiometer experiment showed slightly closer agreement than did the comparisons of radiometer data with rawinsondes. Comparisons of paired data from the vapor channel yielded a correlation coefficient of 0.95 with a rms difference of 0.05 cm, while the liquid water channel data yielded a correlation coefficient of 0.99 with a rms difference of 0.02 mm. The study lends further credence to other theoretical estimations of the accuracy of the radiometer measurement, in that the measured values of integrated vapor are probably within 15% of truth. Measurements of supercooled liquid water are reproducible and very stable. (Author's abstract)
W88-02053

REDUCTION OF ERRORS CAUSED BY BRIGHT BANDS IN QUANTITATIVE RAINFALL MEASUREMENTS MADE USING RADAR,
Royal Signals and Radar Establishment, Malvern (England).
C. J. Smith.
Journal of Atmospheric and Oceanic Technology, Vol. 3, No. 1, p 129-141, March 1986. 8 fig, 3 tab, 15 ref.

Descriptors: *Rainfall, *Radar, *Snow, *Algorithms, *Measuring instruments, *Weather, *Meteorology, Atmosphere, Bright bands, Correction.

The presence of melting snow in a radar beam produces a highly enhanced return which can lead to large errors in estimates of areal surface rainfall made with radar. This paper describes an algorithm for use in real time to detect the presence of bright bands in conventional (non-Doppler) weather radar data. The algorithm derives values for the characteristic parameters of height and intensity of the bright band which can then be used to calculate a correction. Detection relies on the fact that the bright band causes a peak in the apparent rainfall rate measured by the radar at a range dependent on its height above the radar and the elevation of the radar beam. Analysis of about 270 hours of data collected over a period of five months shows that the algorithm is reliable. It detects the bright-band effect when it occurs and there is sufficient precipitation present and does not raise any false alarms. When the precipitation

is patchy it is able to identify the bright band correctly but not with enough confidence to apply a correction. When a correction is applied the 'error' is reduced by approximately 50% on average. (Author's abstract)
W88-02054

SPECIFIC ANALYSIS OF OIL EMULSIONS IN WATER (DIFFERENZIERTE BESTIMMUNG VON OELEMULSIONEN IN WASSER),
Amt fuer Arbeitsschutz, Hamburg (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W88-02082

CONCEPT AND DESIGN OF A SUBSTRATA CONTAINER FOR SAMPLING PERIPHYTON,
Victoria Univ. (British Columbia). Dept. of Biology.
W. P. Lucey, A. Austin, and J. Deniseger.
Water Research WATRAG, Vol. 21, No. 4, p 395-402, April 1987. 1 fig, 5 tab, 48 ref. NSERC Contract A9537.

Descriptors: *Sampling devices, *Design criteria, *Field tests, *Periphyton, Lakes, Limnology.

Limitations in available field sampling methodology and substrata sampler design criteria, to reduce retrieval losses of periphyton, are discussed. The process of retrieving submerged substrates is defined as comprising two distinct operations - (1) in situ substrata encapsulation or containment and (2) subsequent withdrawal of contained surfaces through the water column. A cylindrical closing container which effects no appreciable water disturbance on closing is described. A minimal difference was found between water movement across sampling surfaces contained in the closing system compared with traditional open-type substrata exposure devices. Comparative community sampling studies between open and closing containers in an oligotrophic lake indicate the closing containment system to be an acceptable method for studying periphyton. (Author's abstract)
W88-02337

STORM-SEWER FLOW MEASUREMENT AND RECORDING SYSTEM,
Geological Survey, Reston, VA. Water Resources Div.
F. A. Kilpatrick, and W. R. Kaehrle.
Transportation Research Record TRREDM, No. 1073, p 1-9, 1986. 12 fig, 18 ref.

Descriptors: *Measuring instruments, *Storm sewers, *Flumes, *Weirs, Tracers, Flowmeters, Rainfall, Runoff, Flow.

A comprehensive study and development of instruments and techniques for measuring all components of flow in a storm-sewer drainage system were undertaken by the U.S. Geological Survey under the sponsorship of FHWA. The study involved laboratory and field calibration and testing of measuring flumes, pipe insert meters, weirs, and electromagnetic velocity meters as well as the development and calibration of pneumatic bubbler and pressure transducer head-measuring systems. Tracer dilution and acoustic-flowmeter measurements were used in field verification tests. A single micrologger was used to record data from all the foregoing instruments as well as from a tipping-bucket rain gauge and also to activate on command the electromagnetic velocity meter and tracer dilution systems. A system was developed and suggested for use in measuring all components of flow in a typical storm-sewer system. (Author's abstract)
W88-02351

PILOT STUDY OF SMALL-SCALE MONITORING METHODS OF HERBICIDE RESIDUES IN SOIL AND WATER,
Maine Dept. of Transportation, Bangor. Materials and Research Div.
For primary bibliographic entry see Field 5B.
W88-02358

ELECTROTHERMAL ATOMIC-ABSORPTION SPECTROMETRIC ANALYSIS OF LAKE WATERS FOR MN, FE, PB, AND CD,
Department of Energy, New York. Environmental Measurements Lab.
For primary bibliographic entry see Field 5A.
W88-02359

AUTOMATIC BOTTLE SEALING MECHANISM FOR SEQUENTIAL SAMPLING OF VOLATILE ORGANICS IN WATER,
Environmental Monitoring and Support Lab.-Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W88-02390

WATER UTILITY MAKES USE OF NATIONAL WEATHER SERVICE RADAR,
Washington Suburban Sanitary Commission, Hyattsville, MD.
S. C. Gerwin.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 6, p 62-66, June 1987. 8 fig.

Descriptors: *Remote sensing, *Radar, *National Weather Service, *Planning, *Storms, Weather, Meteorology.

The Washington Suburban Sanitary Commission (WSSC) has tied into the National Weather Service radar system to take measures against the disruptions in water service caused by power outages during frequent severe summer thunderstorms. Advance warnings of potential outages enable the utility to fill elevated storage tanks to maximal capacities, and pumping can be done during off-peak periods when electric rates are lower. In addition, repair crews can be stationed at strategic locations in advance of storms so that they do not have to travel long distances to reach affected facilities. The WSSC purchased receiving equipment for the weather information, but the information itself is furnished free of charge by the National Weather Service. (Author's abstract)
W88-02393

MICROWAVE REMOTE SENSING OF SNOWPACK PROPERTIES: POTENTIAL AND LIMITATIONS,
Northern Forest Research Centre, Edmonton (Alberta).
P. Y. Bernier.
Nordic Hydrology NOHYBB, Vol. 18, No. 1, p 1-20, 1987. 4 fig, 2 tab, 60 ref.

Descriptors: *Remote sensing, *Microwave sensors, *Snow cover, *Snowmelt, *Reviews, *Snowpack, Estimating, Vegetation.

This review explores from a user's viewpoint the possibilities and limitations of microwave-based techniques for the remote sensing of snowpack properties. Mapping of dry snowpacks and detection of melt onset can be achieved with combinations of readings taken at different frequencies with passive microwave sensors. A combination of readings from both passive and active sensors coupled with ground truth data will be required to estimate snow water equivalent under most snow conditions. Snowpack structure and overlying vegetation still present major problems in the estimation of snowpack water equivalent from microwave remote sensing devices. (Author's abstract)
W88-02438

7C. Evaluation, Processing and Publication

FEASIBILITY OF ASSIGNING A PROBABILITY TO THE PROBABLE MAXIMUM FLOOD,
Interagency Advisory Committee on Water Data, Reston, VA. Hydrology Subcommittee.
For primary bibliographic entry see Field 2E.
W88-01612

MODELS OF COASTAL UPWELLING DRIVEN BY JOINT-1 AND AUFTRIEB-77 DATA,
University of East Anglia, Norwich (England). School of Mathematics and Physics.
For primary bibliographic entry see Field 2L.
W88-01620

SEASONAL TRENDS IN THE LONGSHORE DISTRIBUTION OF SURFACE TEMPERATURES OFF SOUTHWESTERN AFRICA 18-34 S, AND THEIR RELATION TO SUBSURFACE CONDITIONS AND CURRENTS IN THE AREA 21-24 S,
Sea Fisheries Research Inst., Cape Town (South Africa).
For primary bibliographic entry see Field 2L.
W88-01625

WATER QUALITY MODELING: A REVIEW OF THE ANALYSIS OF UNCERTAINTY,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W88-01675

SIMULTANEOUS INVERSION OF HYDROGEOLOGIC DATA AND THERMAL DATA: 1. THEORY AND APPLICATION USING HYDRAULIC HEAD DATA,
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W88-01691

CAPABILITY MAPPING FOR SANITARY LANDFILL USING COMPUTER GRAPHICS,
Wisconsin Univ.-Green Bay.
For primary bibliographic entry see Field 5E.
W88-01754

PALEODISCHARGE OF THE LATE PLEISTOCENE BONNEVILLE FLOOD, SNAKE RIVER, IDAHO, COMPUTED FROM NEW EVIDENCE,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2E.
W88-01808

USE OF THE ALGAL GROWTH POTENTIAL TEST FOR DATA ASSESSMENT,
Environmental Protection Agency, Athens, GA. Environmental Services Div.
For primary bibliographic entry see Field 5A.
W88-01855

TOTAL ALKALINITY OF SURFACE WATERS: A MAP OF THE WESTERN REGION,
Corvallis Environmental Research Lab., OR.
Journal of Soil and Water Conservation JSWCA3, Vol. 41, No. 6, p 374-378, November-December 1986. 47 ref.

Descriptors: *Alkalinity, *Surface water, *Maps, Acidic waters, *Acid rain, Water quality, Geohydrology, Topography.

A map of total alkalinity of surface waters in the western region illustrates the general patterns of the relative potential sensitivity of surface waters to acidic deposition. As with geology and physiography, surface water alkalinity in the West varies widely. Most all low-alkalinity lakes and streams occur in the glaciated, high-elevation alpine and subalpine zones of the numerous mountain ranges. In these areas watersheds are small, with steep slopes and thin acidic soils. The lowest alkalinity waters are associated most often with granitic and gneissic rock types, but may also be found in volcanic areas and certain sedimentary areas. Alkalinity concentrations are generally greater in surface waters at lower elevations and often are extremely high in the intermontane valleys, basins, and plateau areas. Development of this map reinforced the fact that a complex set of factors determines a water body's alkalinity. No single factor can explain regional patterns of surface water alkalinity. Also, the level to which these factors are important in influencing alkalinity varies from area

to area. The map provides a tool and rationale for focusing research and survey activities in areas that most likely contain sensitive surface waters. Where complex variations in geology, land forms, soils, hydrology, and other factors affect surface water sensitivity, larger scale and more detailed studies will be necessary to clarify and quantify such relationships. (Lantz-PTT)
W88-01884

COMPUTERIZED SOIL DATA USED IN AGRICULTURAL WATER PLANNING, DENMARK.
Copenhagen Univ. (Denmark).
Soil Use and Management, Vol. 2, No. 4, p 134-139, December 1986. 1 fig, 5 tab, 19 ref.

Descriptors: *Soil properties, *Soils, *Databases, *Data storage and retrieval, *Water management, *Denmark, *Data interpretation, Agricultural engineering, Planning, Soil classification, Soil maps, Classification, Irrigation, Drainage, Wetlands.

A nationwide soil database system was established in Denmark containing soil maps, analytical data, and soil classification. The system is widely used in agricultural planning at county and national levels. The basic data used for the soil database system, and the exploitation of this system in agricultural water planning, are described. The principles for calculating the irrigation needs at a county level as well as those for nationwide mapping of the potential need for drainage are given. Mapping of potentially acid sulfate soils, which gave rise to legislation on drainage of wetlands, is described and the future use of the soil database system in agricultural water planning is discussed. (Author's abstract)
W88-01921

USE OF SOIL AND CLIMATIC DATA TO PREDICT HYDRAULIC LOADING BEHAVIOUR OF IRISH SOILS,
Kinsealy Research Centre, Dublin (Ireland).
For primary bibliographic entry see Field 2G.
W88-01922

SNOW COVER DATA MANAGEMENT: THE ROLE OF WDC-A FOR GLACIOLOGY,
World Data Center A for Glaciology, Boulder, CO.
For primary bibliographic entry see Field 2C.
W88-01961

SOME HYDROLOGICAL ASPECTS OF WEATHER RADAR RESEARCH IN THE UNITED KINGDOM,
Birmingham Univ. (England). Dept. of Civil Engineering.
I. D. Cluckie, P. F. Ede, M. D. Owens, A. C. Bailey, and C. G. Collier.
Hydrological Sciences Journal HSJODN, Vol. 32, No. 3, 329-346, September 1987. 13 fig, 3 tab, 25 ref.

Descriptors: *Data interpretation, *Radar, *Flood forecasting, Weather, Remote sensing, Hydrometeorology, Flooding, Model studies.

In the United Kingdom, as in many other countries, there is an on-going research and development program aimed at extending the use of radar technology to investigate and predict atmospheric phenomena. In recent years this has widened to include quantitative applications in the hydrometeorological and hydrological areas with the advent of real-time flood forecasting and control as a serious possibility for water authorities. Outlined here is some of the more recent work carried out in the flood forecasting and analysis are within the United Kingdom; described are some of the models, results and strategies adopted in this research. An historical perspective is provided but the paper primarily concentrates upon describing more recent activities that have not yet received wide publication. (Lantz-PTT)
W88-01964

DEVELOPMENT OF QUANTITATIVE ESTIMATES OF UNCERTAINTY IN ENVIRONMENTAL RISK ASSESSMENTS WHEN THE SCIENTIFIC DATA BASE IS INADEQUATE,
Environmental Protection Agency, Washington, DC. Office of Drinking Water.
C. R. Cothern, W. A. Coniglio, and W. L. Marcus.
Environment International, Vol. 12, No. 6, p 643-647, 1986. 2 tab, 37 ref.

Descriptors: *Data interpretation, *Risk assessment, *Uncertainty, Estimating, Regulations, Technology, Water pollution effects, Toxicity.

The reasons for developing quantitative estimates of uncertainty in environmental risk assessments are discussed along with a method for developing them which involves scientific judgement. In the situation considered here the regulatory needs are ahead of the science, which makes the development of the estimates of uncertainty more difficult, but not impossible. Quantitative estimates for all uncertainties involved in the estimation of risk resulting from exposure to volatile organic compounds (VOCs) in drinking water are developed and tabulated. By far the largest contribution to the uncertainty in the risk estimates for VOCs in drinking water are due to uncertainty in the extrapolation of the dose-response curve to low levels. The uncertainty due to extrapolation is on the order of 10,000 and 1,000,000. Other components of the analysis may contribute uncertainties of a few orders of magnitude. In general the largest uncertainties are in the toxicological data base and the manipulation of it needed to estimate risk. The data base and manipulations needed to estimate exposure due to VOCs in drinking water were at the more an order to magnitude in uncertainty. (Author's abstract)
W88-02025

INFLUENCE OF RAINGAGE INTEGRATION TIME ON MEASURED RAINFALL-INTENSITY DISTRIBUTION FUNCTIONS,
Communications Research Centre, Ottawa (Ontario).
For primary bibliographic entry see Field 7B.
W88-02046

TECHNIQUE FOR THE ANALYSIS OF THE RESPONSE OF DAMS TO EARTHQUAKES,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W88-02061

ANALYSIS OF PUMPING TESTS IN WELLS WITH CAPACITY EFFECT TAKING INTO CONSIDERATION THE ENTRANCE WELL LOSS (PRISE EN COMPTE DE LA PERTE DE CHARGE A L'ENTREE LORS DE L'ETUDE DES NAPPES D'EAU SOUTERRAINES PAR POMPAGE DANS DES PUITS A EFFET DE CAPACITE),
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
For primary bibliographic entry see Field 2F.
W88-02099

PROCEDURE FOR DETERMINING POTENTIAL GAS QUANTITIES IN AN EXISTING SANITARY LANDFILL,
Dynatech Corp., Cambridge, MA.
For primary bibliographic entry see Field 5E.
W88-02119

EVALUATION OF BIODEGRADATION KINETICS FOR PRIORITY POLLUTANTS,
Engineering-Science, Fairfax, VA.
For primary bibliographic entry see Field 5D.
W88-02210

EVALUATION OF PERCENT REMOVAL VARIABILITY FOR PRIORITY POLLUTANTS IN POTWS,
Indiana Univ. Northwest, Gary. Lab. for Environmental Research.
For primary bibliographic entry see Field 5D.
W88-02222

PERFORMANCE EVALUATION OF THE ANAEROBIC FLUIDIZED BED BIOFILM REACTOR: METHANE PRODUCTION FROM GLUCOSE,
National Cheng Kung Univ., Tainan (Taiwan). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W88-02223

EVALUATION OF ALTERNATIVE HYDROGRAPH METHODS FOR HYDRAULIC DESIGN,
GKY and Associates, Inc., Springfield, VA.
G. K. Young, J. S. Krolak, and J. T. Phillippe.
Transportation Research Record TRREDM, No. 1073, p 28-34, 1986. 4 fig, 3 tab, 12 ref.

Descriptors: *Data interpretation, *Hydrographs, *Hydraulics, *Rainfall-runoff relationships, *Hydrograph analysis, *Hydrodynamics, *Steady state, Rainfall, Runoff, Watersheds, Comparison studies.

A protocol is established to evaluate nine methods for defining hydrographs. Data from one site are used. The context is a need for dynamic hydraulic analysis to downsize drainage structures resulting from designs developed by using conservative steady-state flow assumptions. In addition, the analysis addresses a situation in which measured rainfall or runoff data are missing at a site. Data are generated for a hypothetical site and data requirements and computational methods are evaluated. The test results indicate that Snyder's method and its modification by Constant are superior. The protocol appears to be general enough to use in a comprehensive evaluation of hydrograph generation methods for use in ungauged watersheds. The comprehensive evaluation would draw on a national database and would determine criteria for selecting appropriate hydrograph generation methods to support dynamic hydraulic analysis. (Author's abstract)
W88-02355

DATA BASES: GETTING THE MOST FOR YOUR MONEY,
Montgomery (James M.), Inc., Pasadena, CA.
B. M. Chow.
Journal of the American Water Works Association JAWWA5, Vol. 79, No. 6, p 56-61, June 1987. 5 fig, 3 ref.

Descriptors: *Planning, *Policy making, *Decision making, *Data bases, *Costs, Computers, Design standards, Water quality.

Computerized data bases have wide application in the water industry and can free managers and technical staff to spend more time analyzing data and making decisions. Proper design and attention to user needs and the unique characteristics of water quality and related data will assure that data bases can be used as efficiently as intended. Managers can see tangible progress, and users have input at all phases, not just at the end of the project when it is too late to make any changes. The planning steps require effort on the part of the engineering or laboratory personnel and teamwork with the computer department because the designer must make decisions and articulate what is wanted. This also assures management that the system will fulfill the needs and requirements of the water utility at the least cost. (Alexander-PTT)
W88-02392

SEQUENTIAL SAMPLING OF SNOW IN A RURAL AREA. EXPERIMENTATION AND IDENTIFICATION OF THE ACIDIFYING AGENTS,
Paris-7 Univ. (France). Lab. de Physico-Chimie de l'Atmosphere.
For primary bibliographic entry see Field 5B.
W88-02409

COMPUTERS AND WATER RESOURCES EDUCATION: A PROJECTION,
Polytechnic Inst. of New York, Brooklyn.
G. Bugliarello.

Journal of Water Resources Planning and Management JWRMD5, Vol. 113, No. 4, p 498-511, July 1987. 5 fig, 12 ref.

Descriptors: *Education, *Computers, *Water resources, Water cycle, Technology, Data bases, Artificial intelligence.

The future impact of computers on water resources education is assessed in terms of the nature of the educational process (logical analysis, instruction, and invention), of the components of the water resources field (water cycle analysis and water cycle modification), and of the principal elements of computer technology of relevance to water resources (machines, programs and data bases, networks, work stations, field station, and robots). Advances in computer technology make it possible to envision, through education and research, the rethinking of the organization and operation of the water resource field, the enhancement of a global-systemic view of water resources, the strengthening of socio-technological analyses, the expansion of artificial intelligence approaches, and the creation of custom-made computer chips for water resources ('hydrochips'). (Author's abstract)
W88-02415

ANIMAL DECISION MAKING AND ITS ECOLOGICAL CONSEQUENCES: THE FUTURE OF AQUATIC ECOLOGY AND BEHAVIOR,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W88-02423

OPTIMIZING THE DESIGN OF AN ACTIVATED SLUDGE/SECONDARY CLARIFIER SYSTEM VIA UNIVARIATE SEARCH TECHNIQUE,
National Univ. of Singapore. Dept. of Civil Engineering.
S. L. Ong, and G. S. Lee.
Water, Air, and Soil Pollution WAPLAC, Vol. 34, No. 1, p 1-9, May 1987. 1 tab, 13 ref, append.

Descriptors: *Univariate technique, *Data processing, *Computers, *Wastewater treatment, *Design standards, *Optimization, Automation, Costs, Activated sludge.

A simple and effective univariate search technique suitable for optimizing the design of an activated sludge/secondary clarifier system on microcomputers. The usefulness of the proposed optimal design procedure was tested on an IBM personal computer (IBM-PC). The results of this study indicated that the least-cost design of a typical activated sludge/secondary clarifier system can be obtained within 4 min on an IBM-PC. Besides, the proposed procedure was also found capable of obtaining the optimum solution over a wide range of initial step size of search chosen. (Author's abstract)
W88-02475

8. ENGINEERING WORKS

8A. Structures

DESIGN AND CONSTRUCTION--THEODORE SHIP CHANNEL,
Army Engineer District, Mobile, AL.
R. W. Champion.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 23-29, 3 fig.

Descriptors: *Hydraulic structures, *Hydraulic design, *Construction, *Canals, *Theodore Ship Channel, *Alabama, Channels, Dikes, Dredging, Islands, Erosion.

Theodore Ship Channel, a spur of the Mobile Ship Channel, is situated within Mobile Bay, near Mobile, Alabama. Located on the Alabama coast of the Gulf of Mexico some 120 miles east of New Orleans, Louisiana, the bay receives runoff from a river system that extends over a drainage basin of approximately 45,000 sq mi. The Mobile Ship Channel extends 31 miles in a northerly direction, from the entrance to the bay into the lower reaches of Mobile River. Construction of the Theodore Ship Channel, first conceived in the mid-60's, began in 1979 as a means to relieve traffic congestion in Mobile Harbor. Increased coal exports and the anticipated completion of the Tennessee-Tombigbee Waterway in 1985 were the expected causes of this congestion. From the various evaluations and investigations of the channel, several conclusions and points of interest were discovered. Some of these are: (1) dike slopes vary from about 1 on 30 to 1 on 60 (vertical to horizontal); (2) It is estimated that approximately 61% of the 33 million cu yd of dredged material remained in the island after construction; (3) Between October 1981 (shortly after completion) to October 1983, an average settlement of 10.5 in. was observed around the perimeter of a disposal island constructed in the Bay to handle dredged material; (4) In-place vane shear tests performed on the disposal island shortly after construction showed that the shear strength varied from 40 to 620 psf with an average of 260 psf; (5) There have been a few examples of localized slope degradation, primarily at the southeast corner, yet no catastrophic failures have occurred; (6) Various forms of slope protection, including marsh grass, terrestrial grass, various species of trees, and stone, have been used on the island. Although erosion has caused some minor damage, the island is functioning better than first anticipated. The need for maintenance of the island was foreseen by the District and a contract to raise the island perimeter is underway. This contract requires that the initial dike be raised to an elevation of approximately 12 ft, utilizing suitable material from inside the island. (See also W88-01522) (Lantz-PTT)
W88-01524

IMPROVING CHANNEL RELIABILITY AND PROTECTING THE ENVIRONMENT: A BALANCED APPROACH AT READS LANDING,
Army Engineer District, St. Paul, MN.
D. J. Krumholz.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 30-35, 2 fig.

Descriptors: *Channels, *Dredging, *Sedimentation, Channel erosion, Navigation, Navigation channels.

The Upper Mississippi River (UMR) 9-foot Navigation Channel extends from Minneapolis, Minnesota, to the mouth of the Ohio River at Cairo, Illinois, a distance of 857.6 miles. The St. Paul District of the Corps of Engineers is responsible for operation and maintenance of the northernmost 243.6 miles. The states of Minnesota, Wisconsin, and a portion of Iowa border this stretch of the river. Channel depth is maintained through a series of locks and dams, channel control structures, and by dredging shoals that build in the navigation channel. The typical towboat and barge configuration using this navigation project is 1,200 ft long, 105 ft wide, and drafts 9 ft. Studies conducted from 1974 to 1980 indicated that a shallow sediment trap dredged in the Chippewa River delta would reduce dredging requirements by 90%. Hydraulic studies recommended a shallow, wide trape rather than a deep, narrow trap. Dredged material was disposed of in an abandoned gravel pit located 1 mile inland from the Read's Landing dredge site. A groundwater monitoring program has been instituted to safeguard city and private water supplies in the vicinity of the gravel pit. (See also W88-01522) (Lantz-PTT)
W88-01525

ACCOMODATING ENVIRONMENTAL CONSTRAINTS--MODIFICATION OF A NAVIGATIONAL PROJECT IN COASTAL LOUISIANA,
Army Engineer District, New Orleans, LA.
For primary bibliographic entry see Field 6G.
W88-01532

BEACH RESTORATION ON SANDY HOOK, GATEWAY NATIONAL RECREATION AREA, FROM MAINTENANCE DREDGING OF AMBROSE AND SANDY HOOK FEDERAL NAVIGATION CHANNELS,
Army Engineer District, New York.
J. Zammit, and W. F. Slezak.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 106-110, 2 fig, 1 tab. Contract No. DACW51-83-C-0006.

Descriptors: *Sandy Hook Channel, *Ambrose Channel, *Channel maintenance, *Navigation, *Ecological effects, *Beach restoration, *Dredging, Ecology.

Ambrose Channel and Sandy Hook Channel are the main entrance channels into the Port of New York. Approximately 200 million tons of commerce pass through the Port of New York every year. Sandy Hook Channel is maintained to a width of 800 ft and to a depth of 35 ft at mean low water. This channel serves barge traffic and also deep draft vessels heading to and from berthing areas in the lower Arthur Kill and the Raritan River. Maintenance dredging is required about every 2 years in each of these channels. Approximately 800,000 cu yd are removed every 2 years from Ambrose Channel, while about 500,000 cu yd are removed from Sandy Hook Channel every 2 years. In November of 1981, two lanes of four-lane north-south highway were washed out. Washout of the remaining two lanes of highway and reformation of an inlet through Sandy Hook weere likely to occur unless action was taken to stabilize the beach. In August 1982, a supplemental appropriation was passed to begin providing hydraulic fill to the Sandy Hook area. The project accomplished its goals of providing a wider base for Sandy Hook so that a breach of the spit which would threaten access to the Hook's resources is unlikely. Regular renourishment will be required, however, to maintain the shoreline. Maintenance dredging of nearby navigation channels provides sand of suitable quality and quantity that can be utilized for this purpose. Continued efforts will be made to dispose of clean sands in the offshore zone in lieu of ocean dumping, when direct placement is not feasible. In addition to protection of facilities and the access road, park users have benefited from a wide recreational beach, one of the largest in New Jersey. Further, valuable floral and faunal habitat has been recreated at the site. (See also W88-01522) (Lantz-PTT)
W88-01534

SAFETY CRITERIA FOR CHANNEL DEPTH DESIGN,
Rijkswaterstaat, The Hague (Netherlands).
E. J. van de Kaa.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 213-223, 6 fig, 1 tab.

Descriptors: *Channels, *Design standards, *Safety, Structural engineering, Model testing, Mathematical studies, Risk analysis.

During the design of engineering works in waterways much emphasis is laid on reducing costs (for construction as well as management and maintenance) and increasing benefits. The probabilistic design methods that are being developed are most helpful in this respect. By a better statistical treatment of uncertainties, they have shown that it is often possible to reduce long-established safety allowances considerably and still conserve a high degree of safety. The maximum risk that is acceptable is a point of crucial importance for these methods. How these risks can be dealt with is illustrated with the design of the depth of the channels for 22-m draught ships to Rotterdam. For that design a philosophy was developed to arrive at adequate safety standards. To quantify the developed criteria a number of desk studies, physical scale model tests, mathematical calculations, and studies on a ship maneuvering simulator were performed. A brief description is given of the studies

that were performed to quantify the risks associated with these standards. These risks are compared with similar, existing risks to arrive at quantitative values for the safety criteria that were finally adopted. (See also W88-01522) (Lantz-PTT)
W88-01545

MATHEMATICAL MODELING OF SHIP OPERATIONS IN RELATION TO THE DESIGN OF LARGE HARBOURS,
Maritiem Research Inst. Nederland, Wageningen.
S. G. Tan, and J. A. Pinkster.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 230-262, 22 fig, 31 ref.

Descriptors: *Mathematical models, *Ships, *Navigation, *Harbors, Design standards, Hydraulic profiles, Waves, Jetties, Hydraulic models, Model studies.

The mathematical modeling of some aspects of ship operations in relation to the design of large harbors is described. These aspects concern a maneuvering ship in the harbor, the vertical motions of a ship in shallow water, the motions of vessels moored to jetties, and the behavior of a cutter suction dredge in waves. In most cases the results of the mathematical models show a good correlation with data of model tests which have recently been conducted in the laboratories of the Maritime Research Institute Netherlands. Although more validation studies are still needed, it may be concluded that today the mathematical models may be used as a powerful tool by the designers in the early design stage. It is expected that in the future mathematical models will contribute significantly to judging the performance and safety of ship operations. (See also W88-01522) (Lantz-PTT)
W88-01547

ADVANCE MAINTENANCE IN NAVIGATION CHANNELS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
M. J. Trawle.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 268-273, 7 fig.

Descriptors: *Advance maintenance, *Dredging, *Maintenance, *Navigation channels, Costs, Economic aspects, Shoals, Sedimentation.

Advance maintenance is a procedure that in many cases has the potential of reducing overall maintenance dredging costs by reducing mobilization/demobilization costs and at the same time improving project quality. The two examples of advance maintenance represent effective advance maintenance projects in that both dredging frequencies were reduced and project qualities improved without any increase in shoaling rates. In many cases, the addition of advance maintenance to a project causes some increase in the amount of material trapped, which means that the increased shoaling rate must be weighed against the reduction in dredging frequency or improved project quality to determine the worth of advance maintenance. Since the potential benefits can be substantial, advance maintenance should be given consideration in any navigation channel requiring periodic maintenance. (See also W88-01522) (Lantz-PTT)
W88-01549

STUDY OF THE IMPACTS OF REDUCED DREDGING PROCEDURES ON THE NAVIGABILITY OF THE UPPER MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2J.
W88-01550

UNIQUE DESIGN ASPECTS OF A LARGE-SCALE EXPERIMENTAL SAND BYPASSING SYSTEM,
Coastal Engineering Research Center, Vicksburg, MS.
T. W. Richardson.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 280-286, 4 fig, 9 ref.

Descriptors: *Sand bypassing system, *Oceanside Harbor, *Coastal engineering, *California, *Dredging, Pumps, Hydraulic equipment, Monitoring, Design standards, Performance evaluation.

Several aspects of the design and implementation of an experimental sand bypassing system for Oceanside Harbor, California, that are unique or at least unusual for this type of specialized dredging apparatus are described. The system is intended to be part of a 5-year experiment to determine the feasibility of several sand bypassing concepts on a large-scale, long-term basis. The Oceanside sand bypassing experiment will test several concepts that are unusual to large-scale, long-term installations of this type: (a) Seasonal operation at different locations in the general project site, in response to an analysis of local coastal processes and shoaling patterns; (b) Use of jet pumps, or eductors, as the sand recovery and initial pumping device and a movable jackup barge as the main system platform; (c) Phased construction of the system to allow its final design to evolve in response to lessons learned; (d) Potential use of fluidizers as a means of extending the system's zone of influence; (e) Extensive monitoring of system performance and the effects of continuous bypassing on adjacent beaches; and (f) Application of Supervisory Control and Data Acquisition technology to system control and monitoring. The system was scheduled to begin operation in the development phase configuration in 1985. The sequential testing of its major components will allow separate evaluation of their usefulness. If successful, the Oceanside experiment could develop an entirely new category of equipment for harbor maintenance in conjunction with beach nourishment. (See also W88-01522) (Lantz-PTT)
W88-01551

SIMULATION STUDY OF THE NAVIGABILITY OF THE MAIN SHIP CHANNEL IN MOBILE HARBOR,
National Maritime Research Center-Kings Point, NY. Computer Aided Operations Research Facility.
J. M. O'Hara, and A. D. D'Amico.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 287-291, 1 fig, 1 tab, 1 ref.

Descriptors: *Simulation analysis, *Navigation, *Channels, *Mobile Harbor, *Alabama, Channel depth, Dredging, Sedimentation, Computer models, Navigation channels.

The Port of Mobile is one of the major US coal ports. Transit into and out of the port by large vessels is made possible by an approximately 30-nm-long ship channel extending from the Gulf of Mexico, through Mobile Bay, and into the Mobile River. At present, the controlling channel depth is 40 ft and the channel bottom width is 400 ft throughout most of the channel's length. This controlling depth prohibits many deeper draft vessels of the 50,000 plus DWT class from loading to full capacity. The required light loading of larger vessels makes the movement of cargo more expensive, thus restricting the use of the port by these vessels and lowering the port's efficiency. A proposed harbor modification plan would provide the Port of Mobile with a design which will enable deep-draft vessels in the 50,000 to 150,000 DWT class to transport cargo more efficiently and, thus, lower costs and increase the Port's throughput. Prior to the implementation of this plan, however, it is necessary to determine whether large, deep-draft vessels can safely navigate the proposed 400-ft-wide, 55-ft-deep ship channel. The Computer Aided Operations Research Facility (CAORF) project was directed toward this objective. The design vessel of interest was a loaded 150,000 DWT collier, identical to that described for the Hampton Roads project. To examine the channel's navigability, the proposed harbor design plan was modelled on the simulator. Seven pilots from the Mobile Bar Pilots Association participated in the study and conned the vessel in the proposed design. The pilots were able to navigate successfully in the straight portions of the channel but zones requiring turns proved troublesome. Of 17 channel exists, 16 were associated with runs where course changes were required. A dredging effort to increase channel width in the Port of Mobile that would be restricted to turn areas alone, rather than the entire channel lenght, would represent a considerable cost savings. (See also W88-01522) (Lantz-PTT)
W88-01552

DESIGN AND MANAGEMENT OF DREDGED MATERIAL CONTAINMENT AREAS TO IMPROVE HYDRAULIC PERFORMANCE,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5E.
W88-01602

ISABELLA DAM SPILLWAY KERN RIVER, CALIFORNIA: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
W. G. Davis.
Available from the National Technical Information Service, Springfield, VA. 22161. Technical Report HL-87-11, August 1987. Final Report. 48 p, 2 fig, 6 tab, 10 photos, 14 plates.

Descriptors: *Isabella Dam, *Spillways, *Kern River, *California, *Hydraulic structures, *Model studies, Hydraulic models, Flow patterns, Channel flow.

Tests were conducted on a 1:50-scale model of Isabella Dam Spillway to determine the adequacy of proposed spillway, dam, and channel improvements. The model reproduced an area of the reservoir 800 ft wide by 1,100 ft long, the spillway, and the entire length of the exit channel. Unsatisfactory flow conditions were observed in the vicinity of the spillway crest due to approach conditions to the spillway. Large cross waves, present in the exit channel just downstream of the spillway, resulted in occasional overtopping of the right wall. A grouted rock dike that provided satisfactory flow conditions at the spillway and downstream throughout the exit channel was placed adjacent to the existing spillway approach wall. (Author's abstract)
W88-01613

IN SITU REPAIR OF DETERIORATED CONCRETE IN HYDRAULIC STRUCTURES: FEASIBILITY STUDIES,
Brookhaven National Lab., Upton, NY. Process Sciences Div.
R. P. Webster, and L. E. Kukacka.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB87-004607, A03 in paper copy, A01 in microfiche. Technical Report REMR-CS-6, May 1987. Final Report. 80 p, 15 fig, 3 tab, 21 ref. Support Agreement No. WESSC-85-02.

Descriptors: *Hydraulic structures, *Maintenance, *Concrete repair, *In situ repair, Cracks, Spalling, Pressure injection, Polymers, Feasibility studies, Structure engineering, Case studies, Reinforced concrete.

The results of a program conducted to identify the repair methods and materials currently being used to repair and rehabilitate concrete structures deteriorating as a result of cracking and spalling are presented. These repair methods and materials were evaluated for their applicability to the in situ repair of concrete hydraulic structures. From this evaluation, the following three repair techniques were identified as best suited for in situ repair procedures: pressure injection, polymer impregnation, and addition of reinforcement. Case histories illustrating the application of each technique are presented. Recommendations are made for work to

be performed to make these systems more applicable to the repair of hydraulic structures. (Author's abstract)
W88-01656

STRENGTH DESIGN OF REINFORCED-CONCRETE HYDRAULIC STRUCTURES. REPORT 6: ANALYTICAL STUDY OF THE ULTIMATE BEHAVIOR OF MODEL REINFORCED-CONCRETE CIRCULAR CONDUITS,
Colorado Univ., Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
For primary bibliographic entry see Field 8F.
W88-01657

HYDRAULIC MODEL STUDY OF BRANTLEY DAM SPILLWAY,
Bureau of Reclamation, Denver, CO. Hydraulics Branch.
For primary bibliographic entry see Field 8B.
W88-01666

SEDIMENTATION AND THE ECONOMICS OF SELECTING AN OPTIMUM RESERVOIR SIZE,
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 2J.
W88-01676

TWO ADJACENT PIPE DIAMETERS AT THE OPTIMAL SOLUTION IN THE WATER DISTRIBUTION NETWORK MODELS,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Industrial Engineering and Management.
For primary bibliographic entry see Field 5F.
W88-01678

NONCONVEXITY OF THE RESERVOIR DESIGN PROBLEM,
Hydro-Quebec, Montreal.
A. Turgeon, and G. Brosseau.
Water Resources Research WRERAQ, Vol. 23, No. 8, p 1689-1691, August 1987. 6 fig, 26 ref.

Descriptors: *Reservoir design, *Reservoir sites, *Reservoirs, *Hydraulic design, *Design criteria, Site selection, Sites, Reservoir size, Rivers, Nonconvexities, Economic aspects, Computer models.

A reservoir design problem is concerned with choosing the sites on a river where reservoirs are to be built and determining the size of the installations. The solution must minimize the total construction cost while satisfying a given set of constraints, which differ according to whether the reservoirs are designed for firm water supply, hydroelectric power production, flood control, or low-flow augmentation. It is assumed that the system hydrologies are sufficiently well characterized by their historical monthly flow records and that the problem can be solved by a deterministic optimization technique. The problem has nonconvexities, and ignoring them may lead to a completely incorrect solution. A branch-and-bound method using concave overstimation is developed for dealing with these nonconvexities. This algorithm can be applied to concave cost functions or, in fact, to any separable nonconvex relations, and guarantees a globally optimal solution to be found in a finite number of steps. It has been implemented in Turgeon's software for determining the best development scheme for a river valley in order to eliminate the possibility of not converging to the optimal solution, which users have found unacceptable. (Wood-PTT)
W88-01701

METHOD OF IN-SITU LEACHING OF ORES,
ISL Ventures, Inc., San Francisco, CA.
For primary bibliographic entry see Field 5G.
W88-01778

METHOD OF PRODUCING LARGE BODIES OF ICE,
For primary bibliographic entry see Field 8F.
W88-01781

DREDGE ENVIRON PROTECTION ASSEMBLY,
For primary bibliographic entry see Field 5G.
W88-01784

METHOD FOR CONTAINING OIL AND/OR GAS WITHIN A BLOW-OUT COVER DOME,
Dome Petroleum Ltd., Calgary (Alberta).
For primary bibliographic entry see Field 5G.
W88-01785

OPERATION AND MAINTENANCE OF WATER SYSTEMS IN DEVELOPING COUNTRIES,
Agency for International Development, Washington, DC.
For primary bibliographic entry see Field 5F.
W88-01890

ESTIMATION OF THE RELIABILITY OF A HIGH EARTH-ROCK DAM,
For primary bibliographic entry see Field 8D.
W88-01902

MODEL OF A HIGH-HEAD BOTTOM SPILLWAY WITH INTERACTION OF CONCENTRIC SWIRLED FLOWS,
For primary bibliographic entry see Field 8B.
W88-01906

TURBULENCE INTENSITY IN TRANSITION SECTIONS OF POOLS IN TRAPEZOIDAL CANALS,
For primary bibliographic entry see Field 8B.
W88-01908

DETECTION OF VOIDS BETWEEN STEEL LININGS AND CONCRETE,
V. E. Romanchuk, and I. P. Pomazueva.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 12, p 726-729, June 1987. 2 fig, 3 ref. Translated from Gidrotekhnische Stroitel'stro, No. 12, December 1986.

Descriptors: *Voids, *Hydraulic structures, *Measuring instruments, *Steel linings, *Concrete, Conduits, Data acquisition, Radioisotopes.

The concrete-encased steel structures of high-head, large-diameter conduits require a closed contact at the 'concrete-steel lining' interface for ensure reliability. However, after encasing the steel linings with concrete, zones of voids are often detected. The voids are easily detected by tapping, and are of various sizes in plan and in depth. When detecting voids behind the linings by tapping, it is impossible to distinguish zones with a large depth of the gaps from zones with gaps of 1-3 mm, which as a rule do not pose a danger for the concrete-encased steel structures, since such small gaps lie within the allowable deformations of the steel lining during its loading. Another method for this detection, the radioisotope method, is the only nondestructive method, making it possible to estimate the size of the voids without disturbing the continuity of the steel lining. This technique allows for places for drilling holes needed for grouting to be accurately placed. The effectiveness of grouting can be checked by a repeated investigation of the presence of voids and by measuring their size using the radioisotope void meter. Characteristic of this operation (of the void meter) is that in cases where the mass thickness of the steel lining is close to the measurement depth, the remaining 10% of the radiation being recorded is informative, whereas the density meter completely loses sensitivity to a change in density. The radiation formed in the material of the lining, and composing a considerable part of the total radiation being recorded, is subject to elimination from processing by subtraction or by compensation by a direct current (in the analog scheme of measuring the number of pulses). Case studies are utilized to further illustrate the use of this technique. (Lantz-PTT)
W88-01909

TECHNIQUE FOR THE ANALYSIS OF THE RESPONSE OF DAMS TO EARTHQUAKES,
Texas Univ. at Austin. Dept. of Civil Engineering.
V. Lotfi, J. M. Roesset, and J. L. Tassoulas.
Earthquake Engineering and Structural Dynamics IJEEBG, Vol. 15, No. 4, p 463-490, May 1987. 16 fig, 24 ref, 2 append.

Descriptors: *Data interpretation, *Dams, *Earthquakes, *Dam foundations, Simulation, Concrete dams, Concrete foundations, Finite element method.

A finite element technique is developed for two-dimensional problems of dynamics of dam-water-foundation systems taking into account all interactions rigorously. Water-foundation interaction, which previous developments have only simulated, is considered by imposing proper conditions at the fluid-solid interface. Furthermore, the technique permits treatment of layered foundations. An application to a concrete gravity dam-water-foundation system is presented and discussed. (Author's abstract)
W88-02061

SCOUR PROTECTION FOR LOCKS AND DAMS 2-10, UPPER MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. V. Markussen, and S. C. Wilhelms.
Available from the National Technical Information Service, Springfield, Virginia. 22161. Hydraulic Model Investigation. Technical Report HL-87-4, April 1987. Final Report. 52 p, 22 fig, 7 ref, 2 plates, append.

Descriptors: *Scour, *Locks, *Dams, *Mississippi River, *Hydraulic models, *Erosion, *Model studies, Riprap, Hydraulic structures, Hydraulic engineering.

A 1:70-scale physical model of a typical spillway section of the locks and dams on the Upper Mississippi River was used to determine the probable cause of the scour that has occurred at these projects. It was determined that single-gate operation on the spillways created hydraulic conditions conducive to scour. A 1:42-scale model was used to develop suitable riprap protection. Two gradations of fill material were found suitable and two gradations of riprap were adequate for protection downstream of the tainter gates and roller gates at these structures. The geometric layout of the riprap depended upon the slope of the scour hole to be repaired. Lock and Dam 2 was studied separately because of its unique stilling basin configuration and operation schedule. Riprap protection similar to the other projects was devised for Lock and Dam 2. (Author's abstract)
W88-02283

ENHANCEMENT OF RIPARIAN ECOSYSTEMS WITH CHANNEL STRUCTURES,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
For primary bibliographic entry see Field 4A.
W88-02385

OPTIMAL CANAL LOCATION USING ENVIRONMENTAL MAPPING,
Lower Colorado River Authority, Austin, TX. Water Policy and Programs Div.
For primary bibliographic entry see Field 6A.
W88-02416

8B. Hydraulics

THIRD UNITED STATES - THE NETHERLANDS MEETING ON DREDGING AND RELATED TECHNOLOGY.
For primary bibliographic entry see Field 5G.
W88-01522

COASTAL AND INLET PROCESSES NUMERICAL MODELING SYSTEM,
Coastal Engineering Research Center, Vicksburg, MS.
S. R. Vemulakonda.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 224-229, 10 ref.

Descriptors: *Coastal engineering, *Mathematical models, *Inlets, *Hydraulic profiles, *Ecological effects, Navigation channels, Hydraulic structures, Coastal and Inlet Processes Modeling System, Hydraulic models.

With the improved understanding of coastal processes and the availability of very high speed computers and efficient computation techniques, it is economically feasible to use numerical modeling systems to study the impact of large-scale engineering works on coastal processes. Such systems have the advantage that, unlike physical hydraulic and movable-bed models, once the systems are built and tested, they can be applied to different prototype sites with much less additional effort and cost. Also, they can be used to examine several different problems such as the effects of coastal structures, disposal of dredged material, modification of navigation channels, and estimating maintenance dredging requirements. The development of one such modeling system at the US Army Engineer Waterways Experiment Station, Coastal Engineering Research Center, is described. The system, known as the Coastal and Inlet Processes (CIP) Modeling System, was developed in response to the long-term needs of the Corps of Engineers. (See also W88-01522) (Lantz-PTT)
W88-01546

CEMENT GROUT FLOW BEHAVIOR IN FRACTURED ROCK.
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8G.
W88-01603

HYDRAULIC MODEL STUDY OF BRANTLEY DAM SPILLWAY,
Bureau of Reclamation, Denver, CO. Hydraulics Branch.
E. R. Zeigler.
Report No. GR-87-7, May 1987. 35 p, 23 fig, 1 tab.

Descriptors: *Hydraulic profiles, *Hydraulic models, *Hydraulic structures, *Dams, Spillways, Channel flow, Sediments, Flow velocity, Discharge capacity.

Hydraulic model studies on the spillway at Brantley Dam in New Mexico confirmed the design of the spillway, slotted bucket energy dissipator, and the spillway tailwater channel. Side piers at the spillway entrance were modified to improve spillway flow; and rating curves were obtained for spillway discharge versus reservoir elevation for both free flow and various gate openings. Sediment deposits, immediately upstream from the spillway, were also investigated. Spillway approach velocities washed sediment over the spillway, with minor lowering of the spillway discharge. The slotted bucket energy dissipator worked very well. Immediately downstream from the energy dissipator, the tailwater channel was excavated out of bedrock; and then transitioned upwards to the bottom of the outlet channel. The maximum discharge readily eroded the flood plain downstream from the energy dissipator. A riprapped berm on each side of the tailwater channel protected the dam against erosion. (Author's abstract)
W88-01666

NONCONVEXITY OF THE RESERVOIR DESIGN PROBLEM,
Hydro-Quebec, Montreal.
For primary bibliographic entry see Field 8A.
W88-01701

DEAD ENDS, RED WATER, AND SCRAP PILES,
For primary bibliographic entry see Field 5F.
W88-01896

STRESSES AND FORCES IN LININGS OF TWO NONCIRCULAR PARALLEL TUNNELS,
R. A. Dunaevskii.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 12, p 702-704, June 1987. 4 fig, 2 ref. Translated from Gidrotekhnische Stroitel'stro, No. 12, December 1986.

Descriptors: *Stress, *Tunnel linings, *Tunnel hydraulics, Tunnels, Hydraulic profiles, Mathematical studies.

Noncircular parallel tunnels are components of many hydro developments. However, their behavior is still insufficiently studied, a point which is explained by the difficulty of determining the stresses and forces acting in their linings. A method was developed for calculating the linings of a complex of deep noncircular parallel tunnels under the effect of an internal pressure and the pressure of groundwaters. The tunnels and their linings can have various cross sections, and limitations are imposed on their number only by the possibilities of the computer being used. The rock mass is modeled by a linearly deformable medium in a state of plane strain, and it is assumed that the rock mass is inseparably tied to the lining. The method is based on numerical analytical methods and the Schwart algorithm. It was established that in cases where the relative distance between tunnels, $d/B > 2.5$, the graphs of the stresses and forces of the left tunnel plotted against it can be approximated by hyperbolas, which asymptotically tend to the corresponding values as d/B to infinity in the presence of just one tunnel. In addition, an increase in the relative average thickness of the linings, the stresses at the majority of points decrease, and the bending moments and longitudinal forces increase. (Lantz-PTT)
W88-01904

MODEL OF A HIGH-HEAD BOTTOM SPILLWAY WITH INTERACTION OF CONCENTRIC SWIRLED FLOWS,
A. L. Zuikov, and G. A. Chepaikin.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 12, p 708-712, June 1987. 3 fig, 8 ref. Translated from Gidrotekhnische Stroitel'stro, No. 12, December 1986.

Descriptors: *Spillways, *Hydraulic profiles, *Hydraulic models, *Swirled flows, Flow patterns, Flow profiles, Hydraulic structures, Hydraulic design, Eddies.

Eddy spillways when compared with traditional schemes, have a number of advantages, such as the possibility of re-equipping temporary diversion spillways into service spillways and eliminating the construction of multilevel systems. This can create a considerable reduction of the volumes of works and capital investments on spillways of high-head hydro developments. The need to construct large energy - dissipating structures at the tunnel outlet-stilling basins, walls, dissipators, ski-jumps, etc. is eliminated. An improvement of the cavitation conditions in the waterway as a consequence of reducing the flow velocity can also create a savings, due to a reduction in the requirements imposed on the quality of making the linings. In other cases, the danger of erosion of the linings can be eliminated, reducing operating expenses. The investigated spillway is intended for conventional service use - vertical-lift and radial gates operating in normal free flow regimes with a high capacity, and possibly the passing of trash. This spillway system is based on the effect of the interaction of concentric, oppositely swirled flows, which satisfy the requirements of passage, and the regulation of discharge and necessary dissipations of excess kinetic energy flow at low level, fluctuation loads on conduit walls. Dissipation of the bulk of the excess energy is accomplished on a short section with a length of 1.5-2 diameters of the exit conduit. This leads to convenient layouts under mountain conditions, and in the case of small spillway lengths, in the lower parts of gravity and arch dams. The layout of the investigated spillway system can be different depending on the local conditions, restrictions are not imposed on it with respect to the design and route of the entrance and exit conduits and location of the intakes, gate chambers, hydromechanical equipment, and transition of the swirled flows. The exit conduit can be made both in pressure and free flow variants. This permits wide variation during designing. (Lantz-PTT)
W88-01906

STABILIZED AERATION ON CHUTES,
O. M. Aivazyan.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 12, p 713-722, June 1987. 5 fig, 3 tab, 17 ref. Translated from Gidrotekhnische Stroitel'stro, No. 12, December 1986.

Descriptors: *Aeration, *Hydraulic properties, *Chutes, *Mathematical studies, Mathematical equations, Entrainment, Rapid flow.

The motion of rapid ($Fr > 1$) flows on chutes at certain values of their parameters is accompanied by aeration, i.e., by entrainment of atmospheric air into the liquid medium, which leads to the saturation of the flow with air bubbles whose distribution and concentration depend on the particular conditions. Having occurred on an upstream stretch of a prismatic channel, aeration increases in the direction of motion if the motion is accelerated or decreases if motion is decelerated, stabilizing on reaching a uniform motion. This final stage of development of aeration is examined. According to the principle existing in hydraulics, transition of a gradually varied flow into a uniform flow occurs on an infinite length, but on chutes uniform flow and stabilization of aeration occurs at comparatively small distances from the inlet. Mathematical methods are used to quantify this stabilization. (Lantz-PTT)
W88-01907

TURBULENCE INTENSITY IN TRANSITION SECTIONS OF POOLS IN TRAPEZOIDAL CANALS,
I. S. Rumyantsev, A. B. Maslov, and D. A. Yusupov.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 12, p 723-725, June 1987. 2 fig, 8 ref. Translated from Gidrotekhnische Stroitel'stro, No. 12, December 1986.

Descriptors: *Canals, *Pools, *Hydraulic flow, *Turbulence, *Hydraulic structures, Flow profiles, Baffles, Flow velocity, Hydrodynamics, Dissipators.

Transition for rapid and tranquil flows at places of a change in the longitudinal slopes of trapezoidal canals is characterized by a considerable level of turbulence, large velocity and pressure gradients, and the presence of horizontal and vertical whirlpools. Such phenomena require special studies due to the increased hydrodynamic effect of swinging of the flow on revetment elements of canals. Investigations of the turbulent structure of the flow were carried at the Hydraulic Laboratory of the Moscow Reclamation Institute on a model of a canal with a variable longitudinal bottom slope. The character of the change in the values of the standard deviations of the fluctuations of the longitudinal and transverse components of the longitudinal velocity along the length of a smooth canal is practically the same. Regardless of the Froude numbers and relative width of the canal, the tendancy of the change in the investigated quantities remains constant. The installation of dissipating structures on the transition sections of the pools promotes a decrease of the relative values of the standard deviations of the bottom velocity fluctuation and a shortening of the line of decrease of the investigated quantities. The placement of a slotted baffle wall on the canal bottom leads to a threefold decrease of the standard deviation of fluctuations of the longitudinal component of the bottom velocity. The most effective design is the layout of the slotted baffle wall and block dissipators on a horizontal apron in combination with artificial roughness ribs on the chute. (Lantz-PTT)
W88-01908

PREDICTION OF WIND WAVE CHARACTERISTICS IN LARGE CANALS,
K. I. Zairov, P. P. Listrovoi, and R. R. Masumov.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 12, p 729-732, June 1987. 4 fig, 7 ref. Translated from Gidrotekhnische Stroitel'stro, No. 12, December 1986.

Descriptors: *Bank erosion, *Wind currents, *Waves, *Canals, *Mathematical studies, Channel flow, Hydraulic properties, Mathematical equations.

The operation of a number of large canals indicates that one of the leading factors in the deformation of their channel, is wind abrasion of a channel's slopes. For a quantitative evaluation of wind abrasion, and its prediction when designing unprotected canals, it is necessary to establish the main regularities of the formation of waves under conditions of narrow water areas, and in the presence of a current. To develop a method of calculating wind waves under such conditions, on-site investigations were conducted on the Karshi (KC), Kyzylkum (KKC), and Amu-Bukhara (ABC) main canals. The range of variation of the water width was 40-96 m, depth in the axial zone 4.5-6.0 m, and average current velocity 0.5-0.9 m/sec. The method for calculating wind waves consisted of a two stage approach: (1) values of the wave characteristics were determined at the calculated point under the assumption of no current (n = 0) on the basis of known relations obtained for conditions of seas, lakes, and reservoirs with consideration of the specific features of the water area of canals; and (2) the values of the wave characteristics found were recalculated for conditions of the forward motion of water in the canal channel, using the relation obtained on the basis of investigating wind waves in operating canals, and in aerohydraulic flumes. (Lantz-PTT)
W88-01910

INFILTRATION RATES FOR SEPARATE SEWAGE COLLECTION SYSTEMS,
Gutteridge, Haskins and Davey, Melbourne (Australia).
For primary bibliographic entry see Field 5D.
W88-01953

ANALYSIS OF PUMPING TESTS IN WELLS WITH CAPACITY EFFECT TAKING INTO CONSIDERATION THE ENTRANCE WELL LOSS (PRISE EN COMPTE DE LA PERTE DE CHARGE A L'ENTREE LORS DE L'ETUDE DES NAPPES D'EAU SOUTERRAINES PAR POMPAGE DANS DES PUITS A EFFET DE CAPACITE),
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
For primary bibliographic entry see Field 2F.
W88-02099

SAFE NAVIGATION SPEEDS AND CLEARANCE AT LOWER SILL, TEMPORARY LOCK 52, OHIO RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
S. T. Maynord.
Available from the National Technical Information Service, Springfield, Virginia. 22161. Technical Report HL-87-3, April 1987. Final Report. 76 p, 32 fig, 2 tab, 28 plates.

Descriptors: *Hydrodynamics, *Hydraulic properties, *Navigation, *Locks, *Ohio River, Water level, Towing, Squat, Propellers, Gates, Inland navigation.

This investigation has identified four possible mechanisms for producing tow squat, the vertical drop of the tow due to motion, measured from the still water level, in the temporary lock at Locks and Dam 52. Based on tests with tows either self-propelled or pulled with towing apparatus, this investigation shows that squat for entering tows is determined by different parameters from those for exiting tows. The maximum squat for almost every self-propelled test (entering or exiting) was located at the stern of the towboat. For loaded tows entering the lock, the primary mechanism producing squat was propeller squat.Because tests involving entering tows using the towing apparatus produced very little squat, it was concluded that tow speed is not a significant cause of squat for entering tows. For loaded tows exiting the lock, propeller squat is still an important mechanism for producing squat. This importance was illustrated by the acceleration tests, during which all the tows approached the sill at the same speed. Squat increased for increased propeller speed. The towing tests show tow speed to be another significant factor in defining squat for exiting loaded tows. It was not determined whether this squat was displacement or piston squat. Unloaded exiting tows also have the potential for enough squat to strike the lower sill when operating at high propeller and tow speed. It is likely that displacement, propeller, and moment squat all contribute to the total squat for unloaded exiting tows. The downstream gates for the emtying flume should remain open during tow entry/exit. Entry/exit speeds were higher with the valves open. For equal tow speeds, squat is considerably less with the valves open. (Author's abstract)
W88-02281

SHIP NAVIGATION SIMULATOR STUDY SAVANNAH HARBOR WIDENING PROJECT SAVANNAH, GEORGIA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. C. Hewlett, L. L. Daggett, and S. B. Heltzel.
Available from the National Technical Information Service, Springfield, Virginia. 22161. Technical Report HL-87-5, May 1987. Final Report. 84 p, 21 fig, 7 ref, 4 append.

Descriptors: *Simulation analysis, *Model studies, *Navigation, *Savannah Harbor, *Georgia, Channel flow, Mathematical models, Ships, Statistical analysis, Hydraulic models.

The US Army Engineer Waterways Experiment Station (WES) ship simulator was used to evaluate the proposed channel widening of the Savannah Harbor from Fig Island Turning Basin to Kings Island Turning Basin. The widening would extend the north side of the channel 100 ft. The present channel width of 400 ft causes difficulties in the maneuvering of the 950 ft New York Class containerships that began calling in Savannah approximately 2 years ago. For this reason, the simulation study was conducted using a numerical model of this containership. To generate channel currents for input into the simulation, a hydrodynamic finite element model of the Savannah Harbor was developed as part of the study. Boundary conditions for this model were obtained from a larger numerical model of the entire Savannah estuary system developed by the WES Hydraulics Laboratory Math Modeling Group. Prior to testing, professional pilots from Savannah conducted a series of runs for the purpose of validating the simulation. The simulations consisted of existing and planned conditions. Inbound and outbound runs were performed in opposing currents from an extreme tidal range of 10.5 ft. A total of 42 runs were made, 10 outbound runs in the existing channel, 10 outbound runs in the planned channel, 11 inbound runs in the existing channel, and 11 inbound runs in the planned channel. Professional pilots from the Savannah Pilots Association conned the ship during the tests. Study results were based on a basic statistical analysis in which the means and standard deviations of the following maneuvering parameters in the existing and planned channels were compared: rudder angle, rate of turn, heading, revolutions per minute, speed, and clearances to the channel edge. Results of this analysis showed a small but consistent improvement in navigation in the planned channel. (Author's abstract)
W88-02282

REFLECTION OF A SHALLOW-WATER SOLITON. PART 2. NUMERICAL EVALUATION,
Osaka Univ. (Japan). Faculty of Engineering.
N. Sugimoto, Y. Kusaka, and T. Kakutani.
Journal of Fluid Mechanics JFLSA7, Vol. 178, p 99-117, May 1987. 9 fig, 16 ref, 2 append.

Descriptors: *Hydrodynamics, *Waves, *Solitons, *Mathematical studies, *Beaches, *Shores, *Shallow water, Equations, Velocity, Edge layers.

Reflection of a shallow-water soliton at a plane beach was investigated numerically based on the edge-layer theory. The offshore behavior in the shallow-water region was first obtained by solving the Boussineaq equation under the 'reduced' boundary condition. The spatial and temporal variations of the surface elevation are displayed for two typical values of the inclination angle of the beach. Using these solutions, the nearshore behavior was then evaluated to obtain the surface elevation and the velocity distribution in the edge layer. Both offshore and nearshore behaviors illustrate the reflection problem of a shallow-water soliton. To check the applicability of the edge-layer theory, a 'computational experiment' was based on the boundary-element method, in which the Laplace equation was solved numerically under the full nonlinear boundary conditions at the free surface without introducing the edge-layer concept. Both results show a fairly good agreement for the overall reflection behavior of a shallow-water soliton except for the surging movement at the shoreline. (Author's abstract)
W88-02327

IMPACTS AGAINST THE WALL OF A SCALED-UP FLUIDIZED BED,
Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Delft (Netherlands).
For primary bibliographic entry see Field 3A.
W88-02434

8C. Hydraulic Machinery

MINE WATER - A RESOURCE FOR TRANSPORTATION OF ORES FROM UNDERGROUND MINES,
Luleaa Univ. (Sweden). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 3C.
W88-01589

MAXIMUM DEPTH OF RESERVOIR DRAWDOWN,
P. P. Denisov.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 12, p 673-677, June 1987. 5 fig, 1 tab, 8 ref. Translated from Gidrotekhnische Stroitel'stro, No. 12, December 1986.

Descriptors: *Drawdown, *Reservoir operation, *Water depth, *Powerplants, *Hydroelectric plants, Economic aspects, Mathematical studies, Hydroelectric power, Electric power production.

One of the parameters of a reservoir requiring technical and economic substantiation is its depth of drawdown in the design of low-flow period. It is determined by the useful delivery of water to consumers of the water-management complex, firm power of the hydroelectric station, depth of the water intakes of the hydroelectric station, etc. In the case of multipurpose use of the reservoir, each of the participants of the water-management complex, in the design dry year, imposes its own requirements on reservoir drawdown. For technical and economic calculations it is necessary to plot graphs of the power production of a hydrostation as a function of drawdown of the reservoir both during the design low-flow period and the average long-term (normal) value. The dependence of power production of a hydrostation on the depth of drawdown of a reservoir during the design low-flow period is investigated here. The composition of the structures of the hydro development, elevation of the normal pool level (NPL), reservoir capacity curve, curve of the lower pool levels, turbine and electromechanical equipment of the hydrostation, and graph of inflow to the reservoir are assumed given when conducting these investigations. Calculation of the firm power of a function of the drawdown depth of the reservoir, giving material for a technical and economic determination of the maximum drawdown depth, should be carried out for a prescribed power regime in the

design dry year. Calculations for a prescribed discharge regime distort the general notion about the character of this functional relationship. To avoid errors in determining the firm capacity and power production corresponding to it as a function of drawdown depth, it is necessary to take into account that in the case of streamflow regulation for purposes of the power industry, a reservoir drawdown regime with a constant discharge is contraindicated. (Lantz-PTT)
W88-01900

LOADS ON HYDRAULIC AND WIND TURBINES IN A FREE FLOW AND THEIR POWER CHARACTERISTICS,
V. M. Lyatkher, and Y. B. Shpolyanskii.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 12, p 687-697, June 1987. 9 fig, 2 tab, 18 ref. Translated from Gidrotekhnische Stroitel'stro, No. 12, December 1986.

Descriptors: *Wind turbines, *Hydraulic turbines, *Flow profiles, Hydraulic load, Mathematical studies, Turbines, Model studies, Mathematical models, Blades.

Traditional approaches to analyzing hydro- or aerodynamic loads, and the power efficiency of high-speed wind turbines with a horizontal axis were analyzed. It is shown that the classical estimates of the maximum power of the turbines are based on contradictory hypotheses about the constancy of the pressure over the surface of the stream tube encompassing the turbine, and the uniform distribution of speeds in the plane of the unit. If only the assumption about uniform distribution of speeds (first model of the authors) is kept, then it is possible to calculate the hydro- or aerodynamic loads and power coefficients agreeing with the experimental data. However, this hypothesis does not permit the investigation of nontraditional layouts of horizontal-axis turbines. To eliminate these limitations, a complicated second model was developed and realized on a digital computer. By means of the new models the distributions of speeds and pressures and the power characteristics of turbines with a central fairing, and without it, were compared. It was established that the introduction of a fairing with a diameter up to 0.8R does not cause a worsening of the power characteristics of the turbine. When testing hydraulic or wind turbines in wind tunnels or flumes an overestimation of the loads and power coefficient of the turbines compared with conditions of a free uniform flow is possible. In particular, in the case of a 16% blockage of the wind tunnel by the turbine, the maximum power coefficient can be overestimated by more than 20%. The power characteristics of the turbines change little with increases in the length of the root part of the blade, or the introduction of a central fairing (with a radius up to 0.4R). This makes it possible to examine layouts of wind turbines with a central machine room and relatively short blades, which will make it possible to increase (in the future) the unit capacity of horizontal-axis wind turbines to 20 MW. (Lantz-PTT)
W88-01903

TIDAL POWER GENERATION IN THE FUNDY REGION,
Bowling Green State Univ., OH.
L. G. Peacefull.
The Canadian Geographer CNGGAR, Vol. 30, No. 3, p 254-260, Fall 1986. 2 fig, 11 ref.

Descriptors: *Electrical equipment, *Tidal powerplants, *Ecological effects, *Social aspects, Environmental effects, Bay of Fundy, Powerplants, Nova Scotia, Tidal range, Tidal energy, Economic aspects.

A small, experimental tidal powerplant with a single turbine that generates 19 MW at peak demand was constructed at Annapolis Royal, Nova Scotia. It is the test bed for the straight-flow turbine that Tidal Power Corporation hopes to use in larger plants proposed for other parts of the Bay. When these plants are built they will alter the social and ecological environment of the area drastically. The development of tidal power was reviewed, and the environmental consequences with regard to future changes in the geography of the area were examined. The environmental impact of future barrage construction will be concomitant to change in the tidal range. This change may affect tidal occurrences, shore erosion, daily weather conditions, the temperature of the sea and air, the feeding habits of the fish, and the yield of the local farmers, both close to the barrage and over a large distance from it. All these environmental changes relate to changes in the tidal resonance of the Bay of Fundy, which may become tuned in with the Gulf of Maine thus also affecting the coast of Maine and New England. Social impacts of future barrage construction, including those associated with development of support facilities such as railroads, concrete suppliers, road improvement and maintenance on the north shore and their service industries, were explored. An influx of the predicted additional 3000 employees needed to make this possible into the local area will strain the economy and the infrastructure of the area; a possible boom followed by a bust when the plant is completed and the construction workers leave is contemplated. (Wood-PTT)
W88-01925

IMPROVEMENT OF HYDROPOWER RELEASE DISSOLVED OXYGEN WITH TURBINE VENTING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 5G.
W88-02280

STORM-SEWER FLOW MEASUREMENT AND RECORDING SYSTEM,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W88-02351

8D. Soil Mechanics

INTRODUCTION TO SAND CLOSURES AND RELATED COMPUTATION METHODS,
Svasek (B.V.) Rotterdam (Netherlands).
For primary bibliographic entry see Field 2L.
W88-01553

PROBLEMS OF MUD SOLID INTRUSIONS INTO MINING PITS,
Institute of Geology and Exploration, Xian (China).
L. Jinkai.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 967-978, 2 tab.

Descriptors: *Mud intrusion, *Mining, *Groundwater movement, *Geohydrology, Karst hydrology, Geological studies, Lithology.

Mud often intrudes into mining pits. This affects safety, causes great damage to mining operations, and deteriorates working conditions. A classification of mud intrusion is given with some case histories of intrusions of karst-cave mud and loose materials and rock bursts in coal mines in China. The mechanism of mud intrusions is theoretically studied from geohydrology and engineering geology. The mechanism is closely related to the geological structure, mode of groundwater flow, lithology, physical properties of rock, action of water and rock, mining depth and the crustal stress. Effective methods for the forecast and prevention of mud intrusions are put forward. (See also W88-01554) (Author's abstract)
W88-01584

TESTS OF SOIL-FLY ASH MIXTURES FOR SOIL STABILIZATION AND CANAL LINING,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8G.
W88-01604

LONG-TERM CHANGES IN THE PROPERTIES OF SOIL LININGS FOR CANAL SEEPAGE CONTROL,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. W. Jones.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB87-213955, A04 in paper copy, A01 in microfiche. Report No. REC-ERC-87-1, July 1987. 66 p, 16 fig, 4 tab, 12 ref, 2 append.

Descriptors: *Soil properties, *Canal linings, *Seepage, Soil physical properties, Permeability, Gravel, Frost.

Field and laboratory test data on typical soils in selected Bureau compacted soil (earth) canal linings show long-term physical changes in the linings. These data are indicative of lining performance. The physical properties (particularly unit weight) of the lining soil that affect permeability and canal seepage were tested at various intervals after lining construction. Unit weight was found to vary significantly from one test site to another from year to year. Although there was a general tendency for unit weight to decrease from the top of the lining to the bottom, in some cases it increased. Based on results of laboratory freezing test, changes in unit weight for linings in cold climates were largely attributed to frost action. Generally, there appeared to be less (average) change in unit weight in fine-grained soils of low plasticity without gravel than in soils containing a significant gravel fraction. In one heavy clay lining, loss of unit weight was attributed to wetting and expansion of the soil. Based on field tests of permeability and seepage and on observations of seepage adjacent to the canals, it was concluded that the soil changes found did not significantly affect the expected performance of the canals in controlling seepage. (Author's abstract)
W88-01664

DYNAMIC TESTING OF HOMOGENEOUS EMBANKMENT MODELS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. W. Luehring.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB87-227716, A09 in paper copy, A01 in microfiche. Report No. REC-ERC-87-4, May 1987. 191 p, 19 fig, 4 tab, 44 ref, 6 ref.

Descriptors: *Embankments, *Model studies, *Dynamics, Homogeneity, Mathematical models, Sliding blocks.

Physical model tests were performed on homogeneous cohesionless embankments subjected to idealized ground motion. During the testing, the response of model embankments to a sinusoidal input motion was monitored, and acceleration and displacement data were collected. An analytical model, based on Newmark's sliding blocks subjected to input dynamic motion. Analytical results were compared with physical model test results to assess the validity of the mathematical model. It was concluded that the mathematical model did not accurately predict the deformation of homogeneous cohesionless embankment models because of difficulty in determining the effective shear strength of the material at low normal stresses. (Author's abstract)
W88-01669

CALCULATIONS OF THE CRITICAL SHEAR STRESS FOR MOTION OF UNIFORM AND HETEROGENEOUS SEDIMENTS,
Washington Univ., Seattle. Geophysics Program.
For primary bibliographic entry see Field 2J.
W88-01680

METHOD FOR STRENGTHENING SOFT SOIL,
Chiyoda Chemical Engineering and Construction Co. (Japan).
For primary bibliographic entry see Field 2G.

W88-01779

ESTIMATION OF THE RELIABILITY OF A HIGH EARTH-ROCK DAM,
L. N. Rasskazov, and V. G. Zhelankin.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 12, p 681-687, June 1987. 5 fig, 8 ref. Translated from Gidrotekhnische Stroitel'stro, No. 12, December 1986.

Descriptors: *Stress, *Reliability, *Mathematical studies, *Earth dams, *Dam stability, Mathematical analysis, Dams, Soil characteristics, Safety, Dam construction, Dam failure.

The magnitudes of the statistical variability of physical and mechanical characteristics of soils and loads have a decisive effect on the probability of the scatter of stresses, strain and safety factors, as well as on the level of reliability of a dam. A method of estimating reliability is given which makes it possible to determine the probability that a dam will not reach the limit state of the first group (B) and expected value of the safety factor (K sub s). The use of these criteria in calculating structures opens the possibility for a determination of the level of reliability of earth dams in coordination with the calculated coefficients of the method of limit states. The level of reliability of an earth-rock dam with a height of 350 m with respect to the most dangerous surface of sliding (with the soil characteristics used in the calculation on the basis of analogues) is 0.999941, which is higher than the level of reliability corresponding to a first-class structure. This provides for the safe operation of a real dam, with a sufficiently economical profile, in the case of a possible increase of the variability of soil characteristics during construction. (Lantz-PTT)
W88-01902

STEADY-STATE MOISTURE TRANSPORT IN AN INHOMOGENEOUS POROUS MEDIUM,
I. I. Lyashko, V. F. Kanarskii, G. E. Mistetskii, and N. I. Chernyi.
Hydrotechnical Construction HYCOAR, Vol. 20, No. 12, p 704-708, June 1987. 2 fig, 10 ref. Translated from Gidrotekhnische Stroitel'stro, No. 12, December 1986.

Descriptors: *Porous media, *Water transport, *Soil water, Mathematical studies, Mathematical equations, Dams, Karlov Reservoir.

In connection with the extensive construction of hydraulic structures in which the mass transport of fluid is observed, large capital expenditures and the performance of considerable volumes of works on drainage and cutoff structures are required. A numerical method was developed for calculating steady-state moisture transport in an inhomogeneous porous medium. This can be used by the design engineer when calculating seepage through dams and their foundations. Solutions of test problems, dams on a multilayered permeable foundation, and the Karlov Reservoir dam of the Dnepr-Donbass canal, are given as examples and case studies of the method. (Lantz-PTT)
W88-01905

ANALYSIS OF STRATIGRAPHIC CONTROL ON RIVER BANK FAILURE,
Nigeria Univ., Nsukka. Dept. of Geology.
C. O. Okagbue, and T. K. S. Abam.
Engineering Geology EGGOAO, Vol. 22, No. 3, p 231-245, April 1987. 7 fig, 4 tab, 13 ref.

Descriptors: *River banks, *Stratigraphy, *Niger River, *Bank stabilization, *Bank erosion, Alluvial deposits, Erosion, Model studies.

Most of the rivers of the Niger Delta flow through alluvial deposits whose general stratigraphy is that of cohesionless sand overlain by cohesive silty clay. Erosion and recession of the river banks have constituted a threat to many villages along the various creeks in the delta area. Analyses of the recessional mechanisms indicate that bank failure is initiated by a fluvial erosion of the lower cohesionless bank layer at a much faster rate than the upper cohesive bank layer. This leads to development of overhangs of the upper cohesive materials. The failure mechanism of the river bank is complex, ranging from slip failures in high banks to shearing and toppling failures in low banks. The use of the common slip circle model for stability evaluation appears to be adequate only for high banks. Results obtained for the low banks suggest that the use of this model of stability analyses for low banks may yield misleading results. (Author's abstract)
W88-01994

8E. Rock Mechanics and Geology

CASE STUDY: HYDROGEOCHEMICAL PROSPECTION IN A LEAD-ZINC MINE (VEDRIN, BELGIUM),
Liege Univ. (Belgium). Lab. de Geologie Appliquee.
For primary bibliographic entry see Field 2F.
W88-01591

GROUND FRACTURES DUE TO LONGWALL MINING SUBSIDENCE,
Nottingham Univ. (England). Dept. of Mining Engineering.
B. N. Whittaker, D. J. Reddish, and D. J. Fitzpatrick.
IN: Mine Water, Proceedings of the Second International Congress. Volume 2, September 1985. p 1057-1072, 12 fig, 2 ref.

Descriptors: *Geologic fracture, *Geohydrology, *Model studies, *Groundwater movement, Aquifers, Mines, Excavation.

A large model was used to study fracture development in the ground overlying longwall mining operations. The model utilizes gravity loading only as the means of developing caving and fracturing of the ground above the longwall excavation. The results show fracture development and caving propagation as a longwall face develops from its starting point. The effect of rock strength in the immediately overlying roof is discussed in relation to subsidence development. Special attention is focussed on subsidence development to aquifer horizons. The thickness of cover between the mine horizon and overlying bodies of surface water e.g., rivers and the sea, is considered in relation to underground excavations. A general discussion is included on guidelines for undermining aquifers and surface water bodies with special reference to longwall operations. (See also W88-01554) (Author's abstract)
W88-01592

8F. Concrete

IN SITU REPAIR OF DETERIORATED CONCRETE IN HYDRAULIC STRUCTURES: FEASIBILITY STUDIES,
Brookhaven National Lab., Upton, NY. Process Sciences Div.
For primary bibliographic entry see Field 8A.
W88-01656

STRENGTH DESIGN OF REINFORCED-CONCRETE HYDRAULIC STRUCTURES. REPORT 6: ANALYTICAL STUDY OF THE ULTIMATE BEHAVIOR OF MODEL REINFORCED-CONCRETE CIRCULAR CONDUITS,
Colorado Univ., Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
K. H. Gerstle.
Available from the National Technical Information Service, Springfield, VA. 22161 ADA184-882, A05 in paper copy, A01 in microfiche. Technical Report SL-80-4, July 1987. Report 6 of a Series. 84 p, 60 fig, 2 tab.

Descriptors: *Reinforced concrete, *Hydraulic structures, *Design standards, *Concrete construction, *Strength, *Model studies, Materials testing, Structural engineering, Finite element analysis, Mathematical studies, Cracks, Stress.

Model reinforced concrete rings simulating culvert sections under radial loads were studied using nonlinear finite element analyses. Analytical results were compared with test results, and a realistic strength design methodology for these structures was produced. The following conclusions and recommendations are made: (1) The test specimens tend to redistribute the applied loads in a fashion most favorable to them; (2) Nonlinear finite-element analysis seems to perform well in most cases when compared with test results. In general, analysis underestimates the deflections and tends to overestimate the strength of these rings; (3) Analysis indicates cross-section strength vastly in excess of that predicted by conventional reinforced concrete theory. A detailed study of the local finite element results at critical sections is suggested to explore this further; (4) The diagonal tension failures apparent in some test specimens were not duplicated by analysis. Although some radical cracking was predicted by the analysis, no ring failures due to radial cracking were predicted by the finite element analysis; (5) Finite element analyses indicate that more total load can be carried by these rings under EM loading conditions than under the test loading; (6) Load confinement, both within and normal to the plane of loading, tends to increase the strength of these rings considerably; and (7) A design approach based on plastic analysis may have promise. This method combines the advantages of rationality and simplicity, but must be tested and developed further. (Lantz-PTT)
W88-01657

METHOD OF PRODUCING LARGE BODIES OF ICE,
E. Husebye.
U.S. Patent No. 4,431,346; February 14, 1984. 6 p, 4 fig. Official Gazette of the United States Patent Office Vol 1039, No 2, p 672, February 14, 1984.

Descriptors: *Patents, *Ice, *Water cooling, *Piles, *Freezing, Offshore platforms, Ice formation, Icebergs, Breakwaters, Piers.

Bodies of ice of 30,000 to 50,000 sq m surface area and a height of 200 to 300 meters are used as foundations for offshore oil drilling or production equipment, as breakwaters, quays, for large fill operations, and the like. Ice water can be maintained in the frozen state continuously for 20 years or more in cold as well as in more temperature waters. Creep in the ice due to the great pressures is avoided or controlled. Ice freezing machines produce pieces of ice, which are thereafter frozen into solid ice in a mold floating in water. (Cremmins-AEPCO)
W88-01781

DETECTION OF VOIDS BETWEEN STEEL LININGS AND CONCRETE,
For primary bibliographic entry see Field 8A.
W88-01909

8G. Materials

CEMENT GROUT FLOW BEHAVIOR IN FRACTURED ROCK.
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB87-235420, A04 in paper copy, A01 in microfiche. Report No. REC-ERC-87-7, June 1987. 51 p, 34 fig, 3 tab, 47 ref. Corps of Engineers Contract No. DACW 45-85-D-0003.

Descriptors: *Cement grout, *Flow profiles, *Hydraulic properties, *Grouting, *Geologic fractures, *Materials testing, Water pressure, Grouting, Costs, Monitoring.

A review of cement grout flow in fractured rock is presented. State-of-the-art techniques for grouting are discussed including water pressure testing, type of equipment, methods, grout mix design, and monitoring techniques. Analytic models for flow of grout are explored including viscous and visco-plastic fluid models. A field test program is

planned to evaluate the suitability of the grout flow model to determine if these models are useful monitoring tools during production grouting operations. Site selection criteria for the field test program are provided along with instrumentation and data acquisition methods, and a cost estimate to accomplish the test program. (Author's abstract)
W88-01603

TESTS OF SOIL-FLY ASH MIXTURES FOR SOIL STABILIZATION AND CANAL LINING,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. W. Jones.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-233037, A03 in paper copy, A01 in microfiche. Report No. REC-ERC-86-9, December 1986. 37 p, 19 fig, 6 tab, 10 ref, 2 append.

Descriptors: *Fly ash, *Canal linings, *Soil stabilization, *Materials testing, Canals, Hydraulic structures, Soil porosity.

Laboratory tests were performed on various mixtures of fly ashes with sandy soils to determine possible usage as canal lining to reduce canal seepage and to increase the erosion resistance of the soil. For sands containing a relatively small amount of fines, fly ash reduced soil permeability to an acceptable level. The addition of 2% of either portland cement, calcium sulfate, or hydrated lime to soil-fly ash mixtures significantly increased compressive strength and durability in freeze-thaw and wet-dry tests. Sodium citrate and borax were added, and different temperatures were used to reduce the setting time of mixtures with cementitious fly ashes. For one noncementitious fly ash, lime was added to dune sand and fly ash to provide cementation. For specimens formed pneumatically using laboratory shotcrete equipment, unit weights and compressive strengths of soil, fly ash, and portland cement mixtures were higher than those for specimens formed by impact compaction. The difference was particularly significant when concrete sand was substituted for dune sand. Small field test sections of canal lining placed with manually-operated mixing and compaction equipment were made with soil and fly ash with and without the addition of a small amount of portland cement. The laboratory and field tests indicated that with proper (1)mixtures, (2) field installation equipment, and (3) construction control, ash, particularly with additives, could provide a suitable canal lining. (Author's abstract)
W88-01604

8H. Rapid Excavation

ANALOGY AND DIFFERENCES BETWEEN COAL SLURRY TRANSPORT SYSTEMS AND HYDRAULIC DREDGING,
IHC Holland N.V., Papendrecht (Netherlands).
P. R. H. Verbeck, and W. Van Noordt.
IN: Third United States - The Netherlands Meeting on Dredging and Related Technology, 10-14 September 1984, Charleston, South Carolina. Final Report, March 1987. p 62-70, 3 fig.

Descriptors: *Coal slurries, *Transportation, *Dredging, *Water transport, Hydraulic transportation, Solids, Slurries.

The oil crises in 1973 and 1978 caused many countries to initiate a diversification policy for power generating fuels to reduce their dependence on oil. A renewed interest in the utilization of coal appeared, and around 1980 the prospects for the future use of coal were very optimistic. Although this optimism has since been considerably reduced, coal consumption is expected to rise steadily. As a result, transport capacities are expanding. One possible method of transporting coal is by pipeline. Application of slurry systems is particularly feasible where a transport infrastructure is not yet available because it seems to be the cheapest transportation method. Slurry technology can be applied for both transportation and transshipment, and combined with hydraulic transport can have a very favorable influence on total investment cost. Application of transshipment buoys for offshore operations is an additional potential in case the water depth at the port is not adequate for large coal carriers. Slurry handling of coal has many similarities, but also substantial differences, when compared with the hydraulic handling of solids in the dredging industry. Long distance fine coal slurry and short distance coarse coal slurry transport are discussed as well as the similarities and differences when compared with hydraulic transportation of solids in the dredging industry. As a coarse coal system, a slurry unloading terminal was discussed in more detail. (See also W88-01522) (Lantz-PTT)
W88-01528

8I. Fisheries Engineering

INFLUENCE OF ENVIRONMENTAL FACTORS ON THE CAPE PELAGIC FISHERY,
Sea Fisheries Research Inst., Cape Town (South Africa).
For primary bibliographic entry see Field 2L.
W88-01649

ACUTE TOXICITY OF POTASSIUM PERMANGANATE TO CHANNEL CATFISH FINGERLINGS,
Delta Branch Experiment Station, Stoneville, MS.
For primary bibliographic entry see Field 5C.
W88-02038

STUDIES ON THE ECOLOGICAL EFFECTS OF VARYING THE SIZE OF FISH PONDS LOADED WITH MANURES AND FEEDS,
Asian-Pacific Regional Research Center for Integrated Fish Farming, Wuxi (China).
F. L. Zhang, Y. Zhu, and X. Y. Zhou.
Aquaculture AQCLAL, Vol. 60, No. 2, p 107-116, February 1987. 7 tab, 10 ref.

Descriptors: *Fish ponds, *Manure, *Carp, *Fisheries, *Waste disposal, *Aquaculture, Food habits, Diets, Nutrients, Biomass, Growth, Productivity.

The major species of Chinese carp: grass carp (Ctenopharyngodon idella), bighead carp (Aristichthys nobilis), silver carp (Hypophyhalmichthys molitrix), common carp (Cyprinus carpio), crucian carp (Carassius auratus), and Wuchang fish (Megalobrama terminalis) were cultured using the traditional Chinese polyculture system in different-sized ponds loaded with pig manures. The grass carp were given aquatic grass as supplementary feeds. Two experiments were conduced in 1982 and 1983 using nine fish ponds of sizes varying from 1 mu (667 sq m) to 11 mu (7333 sq m), each for a culture period of 200 days. The average yield attained 6090 kg/ha. The conversion rate of pig manure and aquatic grass to fish biomass was found to average 17:1 and 85:1, respectively. Results indicated higher yield obtained in pond sizes between 3 and 5.7 mu (1999 and 3800 sq m) using standard pond management. Bigger ponds with greater surface area were more difficult to manage and often resulted in lower fish yields. The study also indicated that the fish yield in various experimental ponds was affected by the growth and survival rate of the grass carp, the main species cultured. Dissolved oxygen was found to be lower in smaller ponds and increasing frequency of 'fish surfacing' was noted, while other nutrient levels such as that of total nitrogen, ammonia, nitrite, and phosphate did not appear to have a direct effect on the fish yield. There was no direct relationship between primary productivity, organic detritus, and fish yield in different-sized ponds. However, production of filter feeders (silver and bighead carp) was higher than previously recorded indicating the optimal stocking rate in the polyculture system had been adopted. (Author's abstract)
W88-02039

CULTURE OF MULLET SPECIES IN PONDS RECEIVING IRON CRUSH EFFLUENTS AT EL-BAHARIA OASIS, EGYPT,
General Authority for Fish Resources Development, Cairo (Egypt).
S. Sadek, I. Ittawa, and R. Martello.
Aquaculture AQCLAL, Vol. 59, No. 1, p 23-29, December 1986. 1 fig, 2 tab, 11 ref.

Descriptors: *Wastewater disposal, *Aquaculture, *Mullet, *Fish ponds, *Fisheries, *Iron, Effluents, Industrial wastewater, Ponds, Growth, Algal growth.

An experiment was conducted at El-Baharia Oasis to investigate the culture of mullet species reared in two earthen ponds, both 0.25 ha in area, using the effluent from an iron crusher factory, which maintained a level of 0.07 + or - 0.25 mg Fe/L and a pH of 7.8 + or - 0.60 throughout the experimental rearing period. Similar stocking rates and organic fertilizers were used for both ponds. In the two ponds, similar growth rates were obtained over 8 months, from March to November 1984. These rates were 0.70, 0.15 and 0.20 g/day for Mugil cephalus, Liza ramada and Liza seheli respectively, which were similar to Egyptian fish farm growth rates. The difference between the total yields of the two ponds (226 and 400 kg for pond Nos. 1 and 2 respectively) was mainly due to the harvesting one month earlier of pond No. 1. This was due to the appearance of a blue-green algal bloom of Lyngbya limnetica at a level of 775,000 organisms/L which caused a massive mortality of about 100 kg of fish. (Author's abstract)
W88-02041

WATER RE-USE SYSTEM FOR PRODUCTION OF FINGERLING FISHES IN BRAZIL WITH EMPHASIS ON SOUTH AMERICAN CATFISHES (RHAMDIA QUELENS AND R. SAPO),
Universidade Federal de Santa Maria (Brazil). Dept. Zootechnica.
For primary bibliographic entry see Field 5F.
W88-02080

INVESTIGATIONS INTO THE FEASIBILITY OF A DUCK-FISH-VEGETABLE INTEGRATED AGRICULTURE-AQUACULTURE SYSTEM FOR DEVELOPING AREAS IN SOUTH AFRICA,
Transkei Univ., Umtata (South Africa). Dept. of Zoology.
J. F. Prinsloo, and H. J. Schoonbee.
Water SA, Vol. 13, No. 2, p 109-118, April 1987. 3 fig, 7 tab, 38 ref.

Descriptors: *Fisheries, *Impaired water use, *Aquaculture, *Vegetable crops, *Fish ponds, *Animal wastes, Water resources development, Ducks, Fish, Fish diets, Carp, Tomatoes, Lettuce.

The production potential of a duck-fish-vegetable integrated aquaculture-agriculture farming system was investigated. Pekin ducks were used which were first grown indoors for a period of 28 days before being released into enclosed fish-ponds with shelters over the pond water. Manure and waste feed were dropped directly into the water containing fish in polyculture which included the European common carp, C. carpio, the bighead carp, A. nobilis, silver carp, H. molitrix, and the grass carp, C. idella. Only the common carp received predetermined quantities of supplementary feed based on growth, by means of demand feeders, as other species largely utilized the nutrients discharged into the ponds with the feces of the ducks as well as plankton growths which developed as a result. The nutrient-rich water in the ponds was used to irrigate vegetable crops. Ducks grew to an average of 2.65 kg in a period of 55-56 d. Fish yields obtained exceeded 8 t/ha over a period of 149 d. Substantial yields of vegetable crops were obtained with vegetables such as tomatoes, spinach and lettuce clearly benefitting from the nutrient-rich water. (Author's abstract)
W88-02093

USE OF SHEEP MANURE AS NUTRIENT WITH FISH FEED IN POND FISH POLYCULTURE IN TRANSKEI,
Transkei Univ., Umtata (South Africa). Dept. of Zoology.
J. F. Prinsloo, and H. J. Schoonbee.

Water SA, Vol. 13, No. 2, p 119-123, April 1987. 1 fig, 4 tab, 27 ref.

Descriptors: *Fisheries, *Waste disposal, *Aquaculture, *Fish ponds, *Vegetable crops, *Animal wastes, Water resources development, Tomatoes, Lettuce, Potatoes, Sheep, Carp, Fish diets.

Sheep manure was used as a nutrient in addition to formulated feed in a fish-cum-vegetable integrated production experiment conducted during the summer of 1985 to 1986. Results obtained showed that this kind of manure is not very suitable for use in fish-ponds but that the nutrient rich water produced favorable vegetable growth. Fish species used in the polyculture system included the European common carp C. carpio and the Chinese carps H. molitrix, C. idella and A. nobilis. A total fish yield of almost 5 t/ha was obtained over a period of 149 d. However, fish production results using sheep manure do not compare well with those obtained using fresh duck manure. Irrigation with sheep manured water, when compared to irrigation with fresh water, showed overall higher vegetable production, with lettuce and tomatoes benefitting most (tomatoes: a yield of 88.2 t/ha compared to 64.5 t/ha with fresh water). (Airone-PTT)
W88-02094

GROWTH OF THE CHINESE GRASS CARP CTENOPHARYNGODON IDELLA FED ON CABBAGE WASTES AND KIKUYU GRASS,
Transkei Univ., Umtata (South Africa). Dept. of Zoology.
J. F. Prinsloo, and H. J. Schoonbee.
Water SA, Vol. 13, No. 2, p 125-128, April 1987. 1 fig, 4 tab, 16 ref.

Descriptors: *Fisheries, *Waste disposal, *Food-processing wastes, *Farm wastes, *Carp, *Fish farming, Fish ponds, *Aquaculture, *Fish diets, Vegetable products, Irrigation canals.

Growth of the grass carp Ctenopharyngodon idella was evaluated in fish ponds over a period of 75 d using waste cabbage leaves and kikuyu grass as two alternative foods. The silver carp Hypophthalmichthys molitrix was included for pond management purposes. A yield of almost 2 t/ha was obtained, showing that the grass carp in particular can grow well on vegetable waste materials alone. Accumulation of partly digested plant material in the ponds may lead to eventual declines in oxygen levels. For growth periods of greater than 75 d it would be essential to remove the excess waste materials from the ponds through periodic draining and refilling with fresh water. An alternative would be the use of irrigation canals and/or dams at irrigation schemes where the carp could be kept in cages in monoculture in higher densities than in the present experiment. During the past three years, market testing has proved the acceptability of the various carp species as food fish among the local population. (Airone-PTT)
W88-02095

UTILISATION OF CHICKEN OFFAL IN THE PRODUCTION OF THE AFRICAN SHARP-TOOTH CATFISH CLARIAS GARIEPINUS IN THE TRANSKEI,
Transkei Univ., Umtata (South Africa). Dept. of Zoology.
J. F. Prinsloo, and H. J. Schoonbee.
Water SA, Vol. 13, No. 2, p 129-132, April 1987. 1 fig, 2 tab, 16 ref.

Descriptors: *Fisheries, *Waste disposal, *Fish diets, *Catfish, *Fish farming, *Poultry, Fish, Fish ponds, Farm wastes.

Offal from a chicken broiler farm was macerated and used to grow the catfish Clarias gariepinus at a stocking density of 5 875 fish/ha in ponds over a period of 75 d. Despite a shortage of chicken offal at times and a below normal feeding level of the fish during this period, a yield of more than 2 t/ha was obtained. Apart from migration between the experimental ponds no other loss of fish due to mortalities was experienced. (Author's abstract)
W88-02096

ECONOMIC ANALYSIS FOR FISHERIES MANAGEMENT PLANS.
Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 1981. 318 p. Edited by Lee G. Anderson.

Descriptors: *Economic aspects, *Fisheries, *Management planning, Fish management, Symposium, Legal aspects.

The Fisheries Conservation and Management Act has been in effect for about four years. Just after the law was passed, but before it went into effect, a symposium was held at the University of Delaware entitled 'Economic Impacts of Extended Fisheries Jurisdiction.' The purpose of that symposium was to provide a general economic analysis of the law. The purpose of this workshop was to analyze, from an economist's point of view, the implementation of the Fisheries Conservation and Management Act by studying some actual plans that have resulted, as well as the process of developing and reviewing them. In addition, several special topics related to the economic analysis for fisheries management plans were selected for study. The authors were selected for their knowledge of the particular plan or issue under consideration. This book contains all of the papers presented and, where appropriate, comments on them by preassigned discussants. The book is divided into four main sections; the first gives a general introduction to the topic. Discussed are such issues as the role of economic information, the nature of the economic analysis to provide it, the types of methodologies and data needs required for the analysis, and the federal regulatory policy on marine fisheries management. The second section contains four papers devoted to the economic analysis contained in specific management plans. There were many plans to choose from, and the basis for selection was geographical location and usefulness of the analysis to a wide range of management plans. In the first paper, the Northern Anchovy Management Plan is discussed. In it is described the Gulf of Mexico Shrimp Management Plan. It is shown how economic analysis can be used as an educational tool for explaining peculiarities of the fishery. The Atlantic Surf Clams Plan is discussed, and after providing a general description of the fishery, issues are addressed, such as the usefulness of the moratorium, the substitutability of inputs, and the problems caused by potential monopsony power. The third section of the book contains two papers which provide perspectives on economic analysis for fishery management plans from other countries. The fourth section of the book covers selected economic issues related to most management plans. (Lantz-PTT)
W88-02324

FISH PASSAGE THROUGH POPLAR GROVE CREEK CULVERT, ALASKA,
Alaska Dept. of Transporation and Public Facilities, Fairbanks. Environmental Section.
M. D. Travis, and T. Tilsworth.
Transportation Research Record TRREDM, No. 1075, p 21-26, 1986. 5 fig, 3 tab, 5 ref.

Descriptors: *Fish passages, *Culverts, *Arctic grayling, Design criteria, Flow, Velocity, Fisheries, Highways, Streams.

An experimental procedure was developed to analyze the ability of a highway culvert to pass fish. By using a visual technique, the swimming performance of Arctic grayling (Thymallus arcticus) was monitored in Poplar Grove Creek, Alaska. The highway culvert is 110 ft long and 5 ft in diameter, and is inadequate for fish passage if the Alaska Department of Fish and Game criteria are applied. The drainage area experienced a 20-year flood (Q20) during spring 1985. Excessive pipe velocities prevented the fish from passing the culvert for 8 days. A large portion of the fish in the downstream scour pool were removed by sport fishermen during the period of high flow. Approximately 78 percent of the fish attempting to swim through the culvert were successful when the outlet velocity dropped to 7.3 ft/sec (fps) and about 95 percent swam through when the velocity receded to 6.9 fps. A request for information on fish passage was sent to U.S. and Canadian highway departments and fishery agencies. Forty-four states and all Canadian provinces responded. Twenty states reported that they generally do not have problems with fish passage through highway culverts. Eighteen highway departments reported having a good working relationship with resource agencies when addressing fish passage problems. These 18 states commonly suggested that (a) early coordination should occur between highway and resource agencies during the design phase, (b) culvert invert inverts should be depressed approximately 1 to 2 ft below the natural stream bed, (c) culverts having slopes greater than 1 percent should have a baffling system, and (d) the remaining culvert volume should be able to handle approximately a Q50 discharge. (Author's abstract)
W88-02357

SELECTIVE REMOVAL OF REEF FISH ASSOCIATED WITH AN OFFSHORE COOLING-WATER INTAKE STRUCTURE,
Occidental Coll., Los Angeles, CA.
For primary bibliographic entry see Field 5C.
W88-02364

INFLUENCE OF ENVIRONMENTAL VARIABLES ON THE FISH FAUNA OF THE DEEPER WATERS OF A LARGE AUSTRALIAN ESTUARY,
Murdoch Univ. (Western Australia). School of Environmental and Life Science.
For primary bibliographic entry see Field 2L.
W88-02371

GROUNDWATER TEMPERATURE FLUCTUATIONS AT LYONS FERRY FISH HATCHERY, WASHINGTON,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 2F.
W88-02388

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

DEVELOPMENT OF ENVIRONMENTAL ENGINEERING EDUCATION IN DEVELOPING COUNTRIES,
Qatar Univ., Doha. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W88-01934

COMPUTERS AND WATER RESOURCES EDUCATION: A PROJECTION,
Polytechnic Inst. of New York, Brooklyn.
For primary bibliographic entry see Field 7C.
W88-02415

9D. Grants, Contracts, and Research Act Allotments

FISCAL YEAR 1986 PROGRAM REPORT (MICHIGAN INSTITUTE OF WATER RESEARCH).
Michigan State Univ., East Lansing. Inst. of Water Research.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 229415/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G1232-01, March 1987. 28 p. Contract No. 14-08-0001-G1232. Project No. USGS G1232-01.

Descriptors: *Research, *Information transfer, *Training, *Michigan, *Water Research Institute, Landfills, Liners, Groundwater, Clay, Seepage, Hazardous waste, Public policy, Groundwater quality, Economics, Water quality, Nitrates, Geographic information systems, Well logs, DRASTIC, AGNPS, PRZM, USLE, Models, Nutrients, Watersheds, Surface water, Information dissemination, Technology transfer.

The major thrust of the Michigan Institute of Water Research during the 1986 program year involved activities related to its research program, statewide water resources planning activities, use of geographic information systems and the technology transfer program. Water management planning along with surface and groundwater contamination problems are the top priority issues in the state at the present time. Research projects funded by the Institute of Water Research to address these problems and issues included: the problem of moisture movement through cover clay liners of landfills (02); the analysis of the policy alternatives for managing groundwater quality in Michigan (03); a microcomputer-based groundwater management system developed to link existing water quality and well log information to a geographic information system (GIS) for Kalamazoo County, Michigan (04); application of a modified model simulating the movement of nutrients, chemicals, and particulates through surface and groundwater (05); and the development and implementation of the Institute of Water Research technology transfer program through publication and dissemination of research results, distribution of a water-related newsletter and information materials, responses to requests for information, coordination of conferences and publication of conference proceedings, and the development of educational audio-visual programs (22). (MI St. U., IWR)
W88-01765

FISCAL YEAR 1986 PROGRAM REPORT (DELAWARE WATER RESOURCES CENTER).
Delaware Univ., Newark. Water Resources Center.
R. D. Varrin.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 229399/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G1216-01, July 1987. 28 p. Contract No. 14-08-0001-G1216. Project No. USGS G1216-01.

Descriptors: *Water Research Institute, *Research, *Information transfer, *Training, *Delaware, Acid rain, Agricultural chemicals, Agricultural runoff, Agricultural wastes, Arsenic, Chemistry of precipitation, Corn, Environmental impacts, Geomorphology, Groundwater, Groundwater recharge, Irrigation, Landfills, Leaching, Nitrogen, Oxidation, Percolation, Photocatalysis, Phosphorus, Water pollution sources, Selenium, Toxic chemicals, Tracers, Water pollution prevention.

The Fiscal Year 1986 Delaware Water Research Institute Program was responsive to the water problems of Delaware and the surrounding region. Groundwater contamination management, a most critical research need, was the focus of three projects. Project 02 examined the effect of landfill management on leaching volume and recommended several methods to alleviate leaching from solid-waste disposal sites. Project 05 tested the use of photocatalytic oxidation in the removal of toxic organic chemicals from groundwater and found the process a potentially viable method for clean-up. And 07, a continuation project, evaluated the influence of nitrogen management and irrigation practices on groundwater quality and concluded that nitrate leaching cannot be eliminated in sandy soils in the humid region when irrigated corn is grown. Nonpoint source pollution control was the topic of two projects. Project 03, also a continuation, monitored a meander bend of the Brandywine River to develop a quantitative model of riverbank erosion that can be used to predict erosion rates on Piedmont streams. Project 08 studied phosphorus pollution of surface and groundwater that results from the application of manures and fertilizers. Acid precipitation was the topic of the remaining project, 04, which measured the concentration of arsenic and selenium in the rainfall of the region and evaluated the possibility of using these metalloids as tracers of the acid emission sources. The information transfer component of the program included the publication of three issues of a newsletter about the research projects and presentation of a conference of conservation of natural resources in the community. (Benson-U. of DE)
W88-01766

FISCAL YEAR 1986 PROGRAM REPORT (VIRGINIA WATER RESOURCES RESEARCH CENTER).
Virginia Polytechnic Inst. and State Univ., Blacksburg. Water Resources Research Center.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 229407/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G.1257, July 1987. 26 p, 1 tab, 3 append. Contract no. 14-08-0001-G1257. Project No. USGS G1257-01.

Descriptors: *Water Research Institute, *Virginia, *Training, *Research, *Education, Land use, Sludge utilization, Publications, Groundwater management, Local governments, Drinking water.

The Virginia Water Resources Research Center's 1982-1987 Five-Year Plan has focused on three major water resources problems facing Virginia: (1) barriers to the development of state water resource planning process; (2) adverse impacts of land use practices on water resources; and (3) unresolved issues concerning land application of sewage sludge. During FY-86, the center's research program sponsored nine projects and 13 graduate students. One project concerned water resources planning and provided a workbook for costing water and sewer services to improve the management capacities of local government. Six projects studied land use effects of water resources. Three of the projects examined the consequences, effectiveness, and design of urban and agricultural BMPs. The other three studies focused on identifying, preventing, and mitigating drinking water quality problems. Two projects examined aspects of land application of sewage sludge. During the past year, the center published three research bulletins, sponsored two conferences, continued a citizen awareness program in groundwater protection, and offered two five-day institutes in water resources education. In addition to the bulletins, noteworthy publications included the center's monthly newsletter, handbook for local government officials on groundwater protection methods, and a report detailing the threat to groundwater and surface water from illegal open dumps in Rockbridge County, Virginia. The center's education program received three national awards from professional organizations. A professional article published by a staff member won an award for best paper from the American Water Works Association. (Hrezo & Weigmann-VPI & SU, VWRRC)
W88-01767

FISCAL YEAR 1986 PROGRAM REPORT (MISSOURI WATER RESOURCES RESEARCH CENTER).
Missouri Water Resources Research Center, Columbia.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 229381/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G-1235-01, June 1987. 21 p. Contract No. 14-08-0001-1235. Project No. USGS G1235-01.

Descriptors: *Research, *Information transfer, *Training, *Missouri, *Water Research Institute, Water distribution systems, Microbial ecology, Household plumbing, Bacterial growth, Soil erosion., Nonpoint pollution, No-tillage, Dam safety, Risk analysis, Oxidant, Water purification, Ferrate, Wastewater treatment, Soil surveys, Water table.

The Missouri Water Resources Research Center's goals are: (1) to develop programs in understanding and solving Missouri's water problems, (2) to provide educational opportunities in research for students with an interest in water resources and related fields, and (3) to be actively involved in dissemination of information through all aspects of the media in reaching the researcher, users and citizens of Missouri with informative water related news and research ideas on the future of Missouri's water. Areas of research include: (a) the study and progress of chlorine depletion and bacterial growth in household plumbing systems served by either a surface or a groundwater supply, (b) the study of runoff and infiltration from no-till soybeans with covercrop and effects on soil erosion, (c) the study of the merits of probabilistic techniques for determining the appropriate degree of rehabilitation based on the risk imposed by a dam, (d) the study of Ferrate ion as a potential for replacing chlorine as a substance in application for purification of river and groundwater, and (e) the evaluation of effective on-site waste disposal systems to protect the Lake of the Ozark from further pollution. The information transfer program was very active during this time period. Some of the activities included the beginning of an active Water Resources Seminar Program, and the initiation of a computerized library storage system. A total of 14 students, 5 undergraduates and 9 graduate students were involved in this year's research programs. (Clevenger-MI U., WRRC)
W88-01768

FISCAL YEAR 1986 PROGRAM REPORT (ALABAMA WATER RESOURCES RESEARCH INSTITUTE).
Auburn Univ., AL. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 230009/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G1209-01, July 1987. 27 p. Contract No. 14-08-0001-G1209. Project No. USGS G1209-01.

Descriptors: *Water Research Institute, *Research, *Information transfer, *Training, *Alabama, Wastewater treatment, Pentachlorophenol, Groundwater, Contamination, Migration, Alkalinity, Titration, Anaerobic digesters, Stream linears, Water supply, Stochastic models, Solute transport, Slug test, Water table, Hillside seepage modeling.

Alabama's Water Resources Research Institute at Auburn University provided support for two continuing and five new research projects. The program focused on groundwater and waste treatment. In a continuing project, topographic maps were used to easily identify stream linears as an inexpensive means of siting high-yield wells in the Piedmont area. Slug tests were run in well tapping an unconfined aquifer, a part of a study of hillside seepage. Research was completed on another continuing project to determine amounts of field data required for prediction of contaminant transport in aquifers. Permeability variations caused by reactions between soil and contaminant were modeled to predict migration of contaminants. A new alkalimetric titration was verified in full-scale operating plant tests to measure digestion activity of operating anaerobic digesters. Research is continuing on a sequencing batch reactor system for improved treatment of pentachlorophenol wastewater; 80 percent of the world production of the chemical is used by the wood preserving industry. An improved analytical method for the determination of ozone in water was developed, based on the conversion of ferrous to ferric iron. The Institute remains active in a modest information transfer program, development of support from a variety of extramural sources, and the work of the Alabama Environmental Planning Council. An on-site evaluation of the Institute was conducted April 27-29, 1987, by the Geological Survey. (Warman-Auburn U., WRRI)
W88-01770

FISCAL YEAR 1986 PROGRAM REPORT (MARYLAND WATER RESOURCES RESEARCH CENTER).
Maryland Univ., College Park. Water Resources Research Center.
R. E. Menzer.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 223152/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G-1230-01, July 1987. 33 p, 2 fig, 3 ref. Contract No. 14-08-0001-G1230. Project No. USGS 14-08-0001-G1230-01.

Descriptors: *Research, *Information transfer, *Training, *Maryland, *Water Research Institute, Accretion, Bacteria, Chitin, Chromium, Drinking water, Electron microprobe, Enteric bacteria, Estuaries, Groundwater, Hydrogen peroxide, Infor-

mation transfer, Irrigation, Isotopic tracer, Leaching, Lead radioisotopes, Manure, Nitrates, Nitrogen, Oxidation, Palynology, Photoactivation, Pyrite, Reservoirs, Rivers, Radioactive dating, Sedimentology, Soil amendments, Stable isotopes, Tidal marshes, Trace metals, Vibrio, Wells, Wetlands.

Six projects were funded focusing on nitrate contamination of groundwater, the pollution of the water of the State and Region with toxic chemicals and microbial contaminants, and the impact of changing salinity conditions on future management of the State's water resources. Contamination of groundwater by nitrate used in agricultural fertilization practices is a growing concern. A method to determine the source and movement of nitrate into groundwater using 15-N as a tracer was developed. The impact of irrigation on nitrate movement under varying fertilization practices has been determined. Heavy metal contamination of natural waters in Maryland, resulting from both heavy and light industry in the State, is of concern. The Center has continued to focus on the problem by sponsoring one project dealing with the basic chemistry of the hydrogen peroxide-mediated phototransformation of chromate salts in the Chesapeake Bay that will provide clues to the mechanisms of speciation of such salts in natural waters, and one that considered the mechanisms of heavy metal occlusion in salt marsh soil-sediment systems, emphasizing Fe, Cu, Ni, Pb, and Cd ions, to develop the information needed to predict future impacts of such chemicals on the marsh ecosystem. When certain microorganisms reach natural waters under some conditions, they become non-culturable by standard techniques, but are still viable. This phenomenon has been studied in the Chesapeake Bay in an attempt to understand the conditions in the environment which cause or allow this to occur. It is known that the salinity of the Bay is increasing through natural phenomena. A project has been sponsored to determine the historical effect of such changes on wetlands and its implications for fisheries management. (USGS)
W88-01772

FISCAL YEAR 1985 PROGRAM REPORT (LOUISIANA WATER RESOURCES RESEARCH INSTITUTE).
Louisiana Water Resources Research Inst., Baton Rouge.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 223145/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G-1020-01, March 1987. 30 p, 28 ref. Contract No. 14-08-0001-G-0120. Project No. USGS G1020-01.

Descriptors: *Research, *Information transfer, *Training, *Louisiana, Microbial degradation, Organic compounds, Environmental effects, Organic waste, Clay permeability, Floods, Stochastic analysis, Dispersion, Adsorption, Dioxin, Polychlorinated biphenyls.

The focus of the Fiscal Year 1985 Louisiana Water Resources Research Institute Program was to support both applied and theoretical projects. The applied projects were of immediate value to Louisiana, while theoretical projects concurrently assisted in the solution of long range problems. Water resources problems were addressed relating to flood technology, groundwater, water resources planning, and hazardous waste contamination. Project 02 identified the effects of chlorinated hydrocarbons on the water transmission properties of cohesive deposits which are common to large portion of Louisiana's industrial area. Project 03 initiated biodegradation studies of hazardous chemical waste including PCB and Dioxin. Techniques which had enhanced the degradation of chlorinated hydrocarbons were not effective with dioxin. Project 04 involved using a thermal stratification model to evaluate the design and operation of a proposed flood control reservoir. Project 05 evaluated a groundwater model as a management aid in planning for lignite mining in northwestern Louisiana. The model was used to develop strategies which would enable lignite miners to minimize the adverse effects of their operations on groundwater quality. Project 06 utilized entropy to determine multivariate distributions of flood variables given limited data or information. These distributions were tested using real-world flood data. (Adrian-Louisiana St. Univ.-WRRI)
W88-01773

FISCAL YEAR 1986 PROGRAM REPORT (SOUTH CAROLINA WATER RESOURCES RESEARCH INSTITUTE).
Clemson Univ., SC. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 223954/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G1251-01, June 1987. 39 p, 1 tab. Contract No. 14-08-001-G1251. Project No. USGS G1251-01.

Descriptors: *Research, *Information transfer, *Training, *South Carolina, *Water Research Institute, Agricultural runoff, Agricultural chemicals, Dioxins, Contaminant transport, Capillary fringe, Coastal plains, Cultivation, Deflouridation, Dibenzofurans, Fate of pollutants, Groundwater, Hazardous wastes, Aquifers, Landfills, Pesticides, Reservoirs, Rainfall-runoff relationships, Runoff, Sediments, Seepage, Sediment transport, Agricultural watersheds, Insecticides, Storm runoff, Water pollution sources, Tomatoes, Rainfall simulators, Activated alumina, Manganese, Reservoir operation, Kinetics, Unsaturated zones.

Included in the report are sections on the water problems and issues of the State, the goals and priorities of the total program, the synopses of the program projects and information concerning the information dissemination program. The synopsis containing information regarding research projects funded by the Water Resources Research Institute include: A project by Dr. Thomas Tisue on studying the occurrence of total manganese in the discharges from the new Richard Russell dam located on the upper Savannah River in South Carolina and Georgia. He is attempting to determine if proposed methods of alleviating the problem are adequate. A project by Dr. Thomas M. Keinath is investigating ways of removing fluorides from Black Creek Aquifer water. A project by Dr. Alan Elzerman is studying the occurrence and transportation of PCB's, Dioxins and Dibenzofurans in Lake Hartwell. An attempt to gain understanding of the adsorption and desorption of PCB's in the system is in progress. The project by Dr. Earl Hayter is a continuing project and is directed towards assessing the long term effects of current and surface runoff on aquatic ecosystems. The project by Drs. Abbas A. Fiuzat and Ben Sill was dedicated towards the study of contaminant transport of water in the unsaturated soil zone. The study includes a search of existing models of flow and a verification of the results with existing field or model data. The final research project in this program is an investigation by Drs. Eugene McCall and Geoffrey Scott which is concerned with a comparison of agricultural nonpoint source runoff for no-till and conventional till vegetable crop test plots. A discussion of the Information Transfer Program in effect is also included. (Zielinski-Clemson Univ., WRRI)
W88-01774

FISCAL YEAR 1985 PROGRAM REPORT (SOUTH DAKOTA WATER RESOURCES INSTITUTE).
South Dakota State Univ., Brookings. Water Resources Inst.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 223962/AS. Price codes: A04 in paper copy, A01 in microfiche. Report No. G1044-01, 1986. 40 p. Contract No. 14-080001-G1044. Project No. USGS G1044-01.

Descriptors: *South Dakota, *Water Research Institute, *Research, *Information transfer, *Training, Irrigation, Salinity, Groundwater, Radioisotopes, Pesticides, Recharge.

State water development of agricultural water use and the maintenance of adequate and safe water supplies for industrial and domestic use are high priority issues in South Dakota. The FY85 SWRIP supported five projects involving the concept of total water management. This concept considers the complex interactions of vegetative growth, agricultural management practices, soil chemical and physical properties, the storage and movement of soil water the effect of those interactions on surface and groundwater quality. Another research project investigated the impact of gravel mining on municipal water supply, while still another established the range and extent of naturally occurring radioactive contamination of groundwater. The program was developed cooperatively with higher education, state and federal agencies. Information transfer activities such as seminars and workshops were implemented and over 35 agencies, groups or land owners were directly involved in the program. (USGS)
W88-01775

FISCAL YEAR 1986 PROGRAM REPORT (MISSISSIPPI WATER RESOURCES RESEARCH INSTITUTE).
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161, as PB87 223970/AS. Price codes: A03 in paper copy, A01 in microfiche. Program Report G1234-01, July 1987. 28 p. Contract No. 14-08-0001-G1234. USGS G1234-01.

Descriptors: *Research, *Information transfer, *Training, *Mississippi, *Water Research Institute, Groundwater, Modeling, Management, Sedimentation, Mathematical model, Sediment, Water quality data, Planning, Groundwater management, Land disposal, Hazardous chemicals, Migration, Groundwater pollution, Microbial degradation, Aquaculture.

During the 1986 Program Year the Mississippi Institute was involved in statewide planning activities and research. Water management planning is a top priority issue in the state at the present time. Specific projects include: Project G1234-02 produced a forecast for water use by Standard Industrial Classification (SIC) categories. Project G1234-03 provides information on the rate of degradation of certain wood preserving chemicals migrating through soil. Project G1234-04 (year 1 of 2) evaluates environmental water quality for freshwater shrimp. Project G1234-05 (year 1 of 2) evaluates removal of ammonia from water used in catfish farming by clinoptilolite. Project G1234-22 supported information dissemination and a water management conference. (Proceedings available). Project G1234-23 developed a groundwater quality data base by geographical areas. (Bond-Mississippi St. Univ., WRRI)
W88-01776

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A14-A17	32.95	E07	21.50	D07	325.00	T07	700.00
A18-A21	38.95	E08	24.00	D08	375.00	T08	800.00
A22-A25	44.95	E09	26.50	D09	425.00	T09	900.00
A99	*	E10	29.00	D10	475.00	T10	1,000.00
		E11	31.50	D11	525.00	T11	1,100.00
		E12	34.00	D12	575.00	T12	1,200.00
N01	49.50	E13	36.50	D13	625.00	T13	1,300.00
N02	48.00	E14	39.50	D14	675.00	T14	1,400.00
		E15	43.00	D15	725.00	T15	1,500.00
		E16	47.00	D16	775.00	T16	1,600.00
		E17	51.00	D17	825.00	T17	1,700.00
		E18	55.00	D18	875.00	T18	1,800.00
		E19	61.00	D19	925.00	T19	1,900.00
		E20	71.00	D99	*	T99	*
		E99	*				

*Contact NTIS for price quote.
PRICES EFFECTIVE JANUARY 1, 1988